IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF NORTH CAROLINA
ASHEVILLE DIVISION

STATE OF NORTH CAROLINA *ex rel.* Roy Cooper Attorney General,	)	
Plaintiff,	)	**REDACTED COPY**
vs.	)	Case No.: 1:06 CV 20
TENNESSEE VALLEY AUTHORITY,	)	
Defendant.	)	

NORTH CAROLINA'S PROPOSED FINDINGS OF FACT

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NORTH CAROLINA'S PROPOSED FINDINGS OF FACT

I. TVA's Coal-Fired Electric Generating System:

1. The Tennessee Valley Authority ("TVA") currently operates one of the largest coal-fired power plant fleets in the country, with 59 electrical generating units ("EGUs") at 11 coal-fired power plants in Tennessee, Alabama, and Kentucky. (1818:1-5; 311:12-23)

2. All of the coal-fired electrical generating facilities producing public power in Tennessee are owned by TVA. (1817:3-10) TVA currently operates the Bull Run, Kingston, John Sevier, Gallatin, Johnsonville, Cumberland, and Allen coal-fired power plants in Tennessee. (NC Ex. 58; TVA Ex. 1[1])

3. TVA currently operates the Widows Creek and Colbert coal-fired power plants in Alabama. (NC Ex. 58; TVA Ex. 1) TVA's coal-fired power plants in Alabama comprise approximately 25% of TVA's electrical generating capacity. (1818:14-18)

4. TVA currently operates the Paradise and Shawnee coal-fired power plants in Kentucky. (NC Ex. 58; TVA Ex. 1) TVA's coal-fired power plants in Kentucky comprise approximately 25% of TVA's electrical generating capacity. (1818:14-18)

5. The John Sevier, Bull Run, Kingston, and Widow's Creek plants are TVA's closest plants to the mountain regions of North Carolina and Tennessee. (312:24-313:5; NC Ex. 58; TVA Ex. 1)

[1] North Carolina's exhibits admitted at trial will be referred to herein as "NC Ex. __." TVA's exhibits admitted at trial will be referred to herein as "TVA Ex. __."

II. Emissions from TVA's Coal-Fired Power Plants and Available Control Equipment:

A. Unreasonable Emissions from TVA's Coal-Fired Power Plants:

6. Each of the units at TVA's 11 coal-fired power plants emits sulfur dioxide ("SO_2"), nitrogen oxides ("NO_X"), particulate matter ("PM"), and mercury. (NC Ex. 444 at Resp. No. 5)

7. TVA emits SO_2 and NO_X at an unreasonable rate and "the responsible thing to do would be to take some action to reduce those emissions at a faster rate than [it] currently plan[s] to." (301:22-302:8) TVA's "plants emit emissions well in excess of what is being done by other utilities . . . ." (302:3-17)

8. The emission rates from each of the states where TVA operates – Tennessee, Alabama, and Kentucky – are all unreasonable. (452:21-453:4; 456:4-10) It is necessary for TVA to reduce emissions from all three states in order to achieve a reasonable level of control. (452:21-453:14; 455:11-456:10)

9. Coal-fired power plants are the dominant source of SO_2 emissions in the Southeast region. (191:20-192:25; 1380:12-23; 1385:1-13)

10. SO_2 and NO_X each undergo reactions in the atmosphere to form secondary fine particulate matter ("$PM_{2.5}$"). (334:11-20; 335:7-17; NC Ex. 483; 636:23-637:21; 1380:12-23; 1385:1-9; *see also* NC Ex. 1 at 3.2)

11. $PM_{2.5}$ causes adverse public health effects, poor visibility, and acid deposition. (799:6-14; 334:11-20)

12. NO_X reacts with compounds in the atmosphere to form ground-level ozone. (NC Ex. 443 at Resp. No. 15; 335:7-17; 632:1-16; *see also* NC Ex. 1 at 3.2)

13. Ozone causes adverse public health effects including inflammation of lung tissue, oxidation of materials, and injury to plants. (632:4-16; NC Ex. 443 at Resp. No. 16; NC Ex. 1 at 5.3)

B. Emissions Control Measures Available to TVA:

i. NO_X Emissions Controls:

14. There are a number of options available to TVA to reduce its NO_X emissions, including installation of selective catalytic reduction systems ("SCRs"), installation of selective non-catalytic reduction systems ("SNCRs"), increased use of low sulfur coal from the Powder River Basin, which tends to produce low NO_X emissions, and operating choices that favor use of units that have pollution controls. (335:7-14; 356:24-360:5; 1818:20-1819:1)

15. SCRs are the state of the art controls for NO_X reductions. (1818:20-1819:1) Typically, an SCR can be installed in under two years. (350:12-18; 1819:23-25) An SCR can accomplish 90% removal of NO_X. (357:5-9; 358:25-359:7; 529:23-530:4; NC Ex. 77) SCRs have been installed on some of TVA's coal-fired power plants and are commonly used throughout the industry to control NO_X emissions. (530:17-531:14)

16. An SNCR can be installed within six months and can accomplish a 20-40% removal of NO_X. (357:5-358:24)

17. Reliable vendors and contractors are available to TVA to design and install SCRs at TVA's coal-fired power plants. (380:15-381:7)

18. With limited exceptions, TVA's past NO_X emissions reductions have been driven by compliance with federal and state rules. (1874:8-15) The low-NO_X burners that TVA installed in the early 1990s were the result of compliance with the Federal Clean Air Act Acid Rain Provisions. (1874:20-23; 986:4-7) TVA's installation of SCRs in the early 2000s was the result of compliance with the Federal NO_X SIP Call. (1874:24-1875:20)

19. Currently, the only coal-fired power plant units operated by TVA that have emissions controls to reduce NO_X emissions are Kingston, Bull Run (1824:18-2), Cumberland (1834:16-20), Allen (1835:14-17), John Sevier Unit 1 (SNCR demonstration) (1904:20-25), Johnsonville Units 1-2 (SNCR demonstration) (1835:2-13; 1906:8-10), Paradise (1837:6-10), Widows Creek Units 7 and 8 (1836:6-13), and Colbert Unit 5 (1836:23-1837:3). (*See also* TVA Ex. 2) TVA alleges that by 2013 it will have completed installation of SCRs on Colbert Units 1-4. (TVA Ex. 2; 1894:10-14)

20. TVA operates the NO_X controls that are currently installed on some of its plants only seasonally. (301:10-21) TVA operates most of its SCRs only during the "ozone season" of May through September (1886:12-18; 1887:18-22), and a handful of its SCRs on plants located in eastern Tennessee have been operated during the "shoulder months" of April and October (1849:12-1850:3), in order to gain early reduction credits as was provided in the now-vacated Clean Air Interstate Rule ("CAIR") (1889:7-1891:2).

21. TVA could run its SCRs on a year-round basis right now but does not do so because it does not believe it is required under any applicable law. (1887:18-1888:5) CAIR would have required year-round operation of NO_X controls in order to reduce ambient levels of $PM_{2.5}$. (1888:6-15) TVA now avers that it plans to operate its SCRs on a year-round basis beginning in 2009 despite the vacatur of CAIR. (1863:12-16)

22. TVA's Bull Run plant is in an ozone nonattainment area. (1876:3-10; 2727:23-2728:2; 2729:5-7; 40 C.F.R. 81.343 (2008)) TVA's operation of its SCRs on the eastern side of its system in April and October, which is not required under the NO_X SIP Call (1849:12-17), and its operation of those controls before it was required by the NO_X SIP Call (as described in the Memorandum of Undertaking, TVA Ex. 167) were in TVA's interest in order to expedite the return of the Bull Run area to attainment so Bull Run

would not be subject to stricter environmental regulation (1876:3-13).

23. North Carolina's and TVA's projections for TVA's expected 2013 NO_X emissions (in the 2013 "Base Case") may be too low because the assumption underlying those projections was that TVA would operate its existing SCRs annually in response to CAIR. (320:9-321:9; 385:23-386:13; 388:15-23; 407:3-23; 538:2-24) Now that there is no legal requirement for TVA to operate its NO_X controls year-round it may not do so. (460:12-461:19) If TVA continues to operate its NO_X controls only during the ozone season, its estimated 2013 NO_X emissions would be approximately 200,000 tons per year, as opposed to approximately 115,000 tons per year as estimated by North Carolina in the "Base Case." (385:23-386:13; 464:21-465:3; NC Ex. 53)

ii. SO_2 Emissions Controls:

24. There are a number of options available to TVA to reduce SO_2 emissions, including installation of Flue Gas Desulfurization systems ("FGDs" or "scrubbers"), use of lower sulfur fuel such as Powder River Basin coal or washed Appalachian coal, furnace sorbent injection, and operating choices that favor use of units that have pollution controls. (360:19-363:15; 1821:18-1822:4) Scrubbers are the state-of-the-art pollution control equipment for controlling SO_2 emissions. (1821:18-22) Scrubbers have been installed on some of TVA's coal-fired power plants and are common SO_2 controls throughout the industry. (*Id.*; 366:20-22; 511:3-17)

25. Typically, a scrubber can be installed in two to three years (354:20-23; 368:25-369:6; NC Ex. 83) and can accomplish a 97-99% removal of SO_2 from emissions (360:19-362:10).

26. A number of reputable vendors and engineering companies are available to install scrubbers on TVA's coal-fired power plants. (381:8-382:24)

27. TVA currently operates scrubbers to control SO_2 on only seven of its 59 coal-fired units: Cumberland Units 1 and 2 (1834:16-20), Paradise Units 1-3 (1837:6-10), and Widows Creek Units 7 and 8 (1836:4-10). (*See also* TVA Ex. 2) TVA alleges it will have completed installation of scrubbers on its Bull Run (1831:21-1832:5), Kingston (1832:10-21), and John Sevier (1832:25-1833:1; 1827:9-1828:3) plants by 2013. (*See also* TVA Ex. 2)

28. TVA's past SO_2 emissions reductions have been driven by compliance with federal and state rules and consent decrees. (1874:8-12)

iii. Mercury Emissions Reductions Co-Benefits:

29. Capture of mercury is a co-benefit of installing scrubbers. (336:24-337:10) Use of a scrubber in combination with an SCR reduces even more mercury emissions than use of a scrubber alone; a scrubber and SCR in combination remove over 90% of the mercury emissions. (*Id.*; 383:21-384:2; 1833:19-25)

III. North Carolina's Proposed Remedy:

30. Reasonable levels for TVA's emissions from all of its coal-fired power plants would be 60,000 tons of NO_X per year and 140,000 tons of SO_2 per year. (304:9-18; NC Ex. 95 (admitted at 305:3-20)) TVA's current emissions are well in excess of these reasonable emissions levels. (313:16-314:5; NC Ex. 52)

31. The reasonable emissions level for TVA's emissions proposed by North Carolina is comparable to the cap placed on emissions from power plants operated by Duke Energy and Progress Energy in North Carolina, (304:19-305:2; 389:6-14) the two investor-owned public utilities that operate coal-fired power plants in North Carolina (91:24-92:17). North Carolina's proposed emissions cap on TVA's SO_2 and NO_X emissions factors in growth between now and 2013 using the U.S. Environmental Protection Agency's ("EPA's")

growth estimates for TVA, Duke Energy, and Progress Energy. (304:19-305:2; 314:17-316:24)

32. North Carolina's expert in air pollution control technologies and costs, Dr. Jim Staudt (284:17-23), developed one unit-by-unit control strategy that TVA could implement to meet the proposed emissions caps (392:25-393:4; 393:19-24; 400:7-12; 407:3-410:20; NC Ex. 54; NC Ex. 97). The controls included in the scenario formulated by Dr. Staudt, in addition to proper operation and maintenance of the controls already installed on TVA's plants, consist of:

- **Allen:** Install a scrubber on all three units
- **Bull Run:** Complete installation of the scrubber on Bull Run's single unit
- **Gallatin:** Install a scrubber on all four units and SCRs on all four units
- **John Sevier:** Install scrubbers on all four units and SCRs on all four units
- **Kingston:** Complete installation of scrubbers on all nine units
- **Johnsonville:** Install scrubbers on all 10 units and SNCRs on all 10 units
- **Shawnee:** Install a scrubber on Units 1-9, SNCRs on Units 1-5, and SCRs on Units 6-9
- **Colbert:** Install scrubbers on all five units and SCRs on Units 1-4
- **Widows Creek:** Install scrubbers on Units 1-6 and install SCRs on Units 1-6

(*See* NC Ex. 54; *Compare* NC Ex. 97 *with* NC Ex. 96; 409:16-411:10)

33. Dr. Jim Staudt, North Carolina's expert in air pollution control engineering and costs (284:17-23), holds a bachelor's and master's degrees and a Ph.D. in mechanical engineering (278:21-279:7), with a concentration on engineering of coal combustion (283:20-284:4), as well as a certification as a Chartered Financial Analyst, which

provides him with the skills to understand how companies make business decisions with respect to air pollution control technology (280:9-281:4). Dr. Staudt has experience working for various air pollution control equipment providers (278:21-279:8) and has worked extensively with EPA in the area of mercury control and the cost of air pollution control equipment (282:10-283:19). Dr. Staudt is also a member of the Institute of Clean Air Companies. (284:25-287:23) North Carolina's Exhibit 425 (admitted at 276:18-23) is a more complete statement of Dr. Staudt's qualifications.

34. TVA can reduce its emissions to the reasonable levels requested by North Carolina by using well-accepted and well-understood technologies that are common throughout the industry and that TVA itself already uses at a number of its plants. (306:11-19; 507:18-508:15; 510:5-9; 530:14-16; 320:9-21; 325:22-326:13; *see also* 1818:20-1819:1; 1821:18-1822:4; 365:9-21; 366:16-22) Scrubbers and SCRs are "very standard technology" (325:22-326:13) for controlling emissions of SO_2 and NO_X. Approximately half of the coal fired generation in the United States is equipped with scrubbers and SCRs. (513:12-514:5; 530:17-531:8)

35. It is feasible for TVA to meet the emissions levels proposed by North Carolina by 2013. (305:22-306:10)

A. Technical Feasibility and Reasonableness of North Carolina's Proposed Remedy:

36. It is technically feasible for TVA to achieve the emissions levels sought by North Carolina using established technologies. (407:3-411:20; NC Ex. 54) None of TVA's witnesses disputed this fact.

37. A 2013 deadline gives TVA a reasonable amount of time to install additional control devices or make other operational changes to meet the emissions caps. (319:17-22)

38. There is sufficient capacity in the labor and material sectors for TVA to meet the emissions caps proposed by North Carolina by

2013. (459:1-460:8; 461:20-462:18; 480:13-491:19; 492:9-498:20; NC Exs. 113, 114, 116)

39. Installation of SCR and scrubber technologies require a unit outage to be brought online, but that could be accomplished during TVA's normal service outage. (NC Ex. 445 at 30:24-31:13; NC Ex. 452 at 97:21-5) Outages to bring these technologies online would not negatively impact TVA's ability to supply electricity to its customers. (401:3-402:3; 354:20-356:23)

40. There is no reason that TVA would have to close down any of its coal-fired power plants to meet the reasonable emissions rates sought by North Carolina by 2013. (363:16-24; 364:21-365:8)

41. The proposed emissions caps on TVA would require a 310,000 ton reduction in SO_2 emissions per year (a 69.5% reduction) and a 55,000 ton reduction in NO_X emissions per year (a 48.3% reduction). (384:8-387:4; NC Ex. 53) Installation of controls for SO_2 and NO_X would likely also result in a co-benefit of a 1,584 pounds-per-year reduction in mercury emissions (a 54.3% reduction). (*Id.*) TVA's current emissions are at least three times, and close to four times greater than the reasonable emissions levels determined by North Carolina. (388:24-389:18; NC Ex. 52)

42. Capping emissions from a group of plants provides a utility with operational flexibility because it can put the controls where it believes they will be the most beneficial and cost efficient. (325:1-5; 360:6-18)

43. Emissions caps ensure that scrubbers and SCRs are properly maintained and operated, and that they are not bypassed. (323:14-25; 457:21-458:11; 598:15-599:18; 600:12-602:4)

B. Financial Feasibility and Reasonableness of North Carolina's Proposed Remedy:

44. Dr. Susan Tierney, North Carolina's expert in utility economics and financial analysis (1634:18-25), evaluated whether the remedy proposed by North Carolina would be financially feasible and financially reasonable for TVA to complete (1635:6-17). Dr. Tierney is a Managing Principal of the Analysis Group and has been involved in issues relating to electric power markets and utility regulation policy for approximately 25 years. (1640:18-1641:4) She has served in a number of government positions that included evaluating the economic feasibility of utility programs – including as Director of Massachusetts's State Energy Facility Siting Council, the Commissioner of Massachusetts's Public Utility Commission, the Director of Massachusetts's Environmental Affairs, Chairman of Massachusetts's Water Resources Authority, and as Assistant Secretary of Policy at the U.S. Department of Energy. (1641:17-1643:23) As Chairman of Massachusetts's Water Resources Authority, Dr. Tierney directed a multi-million-dollar cleanup of Boston Harbor under a Federal Court Order. (1642:24-1644:6) Dr. Tierney has published articles in the field of utility economics and financial analysis (1646:8-25), has served on a number of committees in the field (1647:1-13), and serves on the Boards of Directors of several companies that are involved in the electric industry (1647:14-1648:11). North Carolina's Exhibit 435 is a more complete statement of Dr. Tierney's qualifications.

45. It is "financially feasible and reasonable for [TVA] to undertake the pollution control equipment program" sought by North Carolina. (1635:20-24; 1652:10-17; 1684:7-16; 1710:11-1711:2) TVA has not disputed North Carolina's expert's financial analysis or conclusion that it is financially feasible and reasonable to meet the emissions cap proposed by North Carolina. (NC Ex. 453 at 66:16-21, 77:9-14, 148:7-19, 175:3-10, 176:24-177:4, 180:16-22)

46. Dr. Staudt estimated that the total capital cost of the proposed control scenario for TVA to meet the emissions caps would be

approximately $3 billion, amortized over 30 years, with operation and maintenance costs of approximately $220 million per year. (421:6-21; 423:8-22; NC Exs. 56, 106)

47. TVA disputed Dr. Staudt's capital cost estimate for additional SO_2 and NO_X controls, and estimated the capital costs would be in the range of $5 billion. (424:6-425:17; 2070:5-17) TVA did not dispute Dr. Staudt's estimated operation and maintenance costs. (424:3-5)

48. Dr. Staudt determined that, even using TVA's capital cost estimates, the total cost for the example system-wide control strategy would be $4.2 billion, if TVA improves the performance of some of its existing scrubbers, uses lower sulfur coal, or makes certain operational changes instead of installing new scrubbers at each plant. (426:1-427:17)

49. TVA would also have the potential for fuel savings of approximately $500 million per year if it retrofits all of its coal-fired power plants with scrubbers because TVA will be able to burn higher sulfur/lower cost coal at those facilities. (427:18-429:14; NC Ex. 484) North Carolina's control scenario will cost approximately $320 per ton SO_2 removed, when the fuel cost savings are considered. (NC Ex. 484; 434:3-436:21)

50. TVA can afford to make a large investment in pollution control devices because TVA can operate and make investments more cheaply than other electric companies. (1668:16-1669:3; 1671:14-15) TVA's debt enjoys the highest possible rating (2833:24-2834:4), resulting in a lower cost of borrowing money (1666:13-25; 1667:18-1669:3; 1671:3-15; 1677:12-20; 1678:17-1679:6).

51. "In simplest terms, TVA stands head and shoulders among its colleagues in the electric utility industry as being a very strong, creditworthy entity." (1678:21-23)

52. TVA has a statutorily mandated $30 billion debt ceiling. (1651:22-1652:2; 1715:25-1716:5)

53. Given either the cost estimated by North Carolina of $3 billion or by TVA of $5 billion, and taking into consideration its current debts, TVA will not exceed its statutory $30 billion debt ceiling on bonds by investing in pollution control equipment. (1685:24-1690:2; *see also* NC Ex. 446 at 24:5-14, 25:6-11, 27:3-21, 29:10-18)

54. TVA has the authority to set its electricity rates at a level required to manage its debt and keep producing electricity. (1660:24-1663:2; 1665:13-1666:4; 1679:7-20; 1710:11-1711:2; NC Ex. 446 at 23:14-24:1, 24:5-14, 31:8-14, 37:16-38:4)

55. TVA's rates are among the lowest in the country. (1663:3-9; NC Ex. 403; 2834:9-11; NC Ex. 446 at 97:25-98:4)

56. Any resulting incremental rate increase "would be of a size that would be absorbable by TVA's customers." (1690:18-1691:6) If the proposed remedy were to cost $5 billion in capital costs, as TVA claims, the incremental impact on rates in the highest rate year would be approximately $4 a month for the average customer. (1694:2-17; NC Ex. 400) If the proposed remedy costs $3 billion as North Carolina has estimated, the incremental impact on rates in the highest rate year would be approximately $3 a month for the average customer. (1679:21-1680:12; 1694:5-17; NC Ex. 399) TVA has authority to determine how best to structure and implemental incremental rate increases such as this. (1733:14-1736:1) TVA is not at risk of losing customers due to any rate increase because it is protected within a statutorily mandated "fence" (1659:18-1660:18; NC Ex. 446 at 65:19-66:5) that is not likely to be removed (1695:16-1696:13).

57. The benefits of fuel cost savings associated with burning a less expensive coal once the pollution controls are in place were not factored into North Carolina's financial analysis of the required cost of the proposed remedy or its impact on TVA's rates. (1694:18-

1695:1) Both North Carolina's witness and TVA's witness testified that there could be considerable fuel-cost savings at units equipped with the most advanced pollution controls. (427:18-430:3; 2049:22-2053:3)

IV. Air Quality Modeling:

58. TVA has known since at least 2002, through its participation in Southern Appalachian Mountains Initiative, that its emissions cross into North Carolina. (1964:14-19)

59. The high pressure systems that form in the southeast United States "tend to cause the pollution to move from west to east in a circular pattern" which carries pollution from all of TVA's power plants including those in Alabama, Tennessee, and Kentucky, into North Carolina, causing impacts there, as well as impacts in Alabama, Tennessee, and Kentucky. (784:11-24; 789:11-790:20; 2687:18-2688:16)

60. In the Southeast, reductions in SO_2 emissions result in fairly linear decreases in $PM_{2.5}$ downwind from the sources. (2320:1-20)

A. Air Quality Modeling Conducted by North Carolina:

61. Mr. Neil Wheeler, North Carolina's expert in air quality analysis and modeling (623:12-16), is a senior vice president at Sonoma Technology Incorporated ("STI"), where he directs the company's atmospheric modeling program, including use of photochemical, meteorological, and emissions models (616:12-19). Mr. Wheeler holds a masters degree in natural science, with a concentration in physics. (619:1-10) Mr. Wheeler has served as a weather officer in the U.S. Air Force (618:10-25), the manager of the California Air Resources Board's control strategy modeling section (620:6-13), and as the head of the North Carolina Supercomputing Center's modeling applications group (620:14-19). In these positions, Mr. Wheeler has been involved with running and evaluating air quality models for over 25 years. (621:17-622:17) North Carolina's

Exhibit 427 is a more complete statement of Mr. Wheeler's qualifications.

62. Mr. Lyle Chinkin is North Carolina's expert in air quality analysis, including emissions inventories (771:13-20) and holds undergraduate and graduate degrees in atmospheric science and meteorology (771:21-772:3). Mr. Chinkin has held the positions of Manager of Emissions Modeling at SAI, where he developed emissions inventories for hundreds of cities worldwide (773:12-14), and as the President of STI, which works in all aspects of air quality research, applications, and modeling (774:5-15). STI performs daily air quality modeling for EPA and the U.S. Forest Service. (774:16-775:2) North Carolina's Exhibit 426 is a more complete statement of Mr. Chinkin's qualifications.

63. Messrs. Wheeler and Chinkin used the state-of-the-science Community Multiscale Air Quality ("CMAQ") model to quantify the air quality benefits that would be achieved if TVA were to reduce its emissions to the levels sought by North Carolina. (616:24-617:4; 629:6-24; 633:8-17)

64. Messrs. Wheeler and Chinkin modeled a full year of meteorology with emissions from TVA as well as emissions from all other sources in the modeling domain to understand the impact of TVA's emissions on air quality in the region, as well as the benefits of removing TVA's excess emissions from the system. (673:6-674:23) Messrs. Wheeler and Chinkin focused on impacts in, and improvements to, 24-hour average $PM_{2.5}$, annual average $PM_{2.5}$, peak 8-hour ozone, and annual average ozone levels. (*Id.*)

65. North Carolina's modeling focused on the differences between the 2013 "Base Case" and the 2013 "Control Case." (673:6-674:23) North Carolina's 2013 "Base Case" is reflective of current conditions with the year-round operation of TVA's SCRs. (409:2-5; 853:23-854:5; 386:19-24; *See also* NC Exs. 98, 99; 658:3-13) North Carolina's 2013 "Control Case" represents TVA's emissions if it were to comply with the limits sought by North Carolina. (720:6-

13; 408:15-409:1; 409:6-411:20; *see also* NC Exs. 100, 101; 658:14-22) The only difference between the "Base Case" and the "Control Case" scenarios modeled by North Carolina is TVA's emissions levels. (719:15-720:18)

66. It is standard practice in air quality modeling to model a future year emissions inventory based on a reasonable time for a given source to install controls. (786:20-787:5) The modeled year itself is irrelevant when comparing a "Base Case" against a "Control Case" because everything is held constant except for the emissions from the source at issue. (*Id.*)

67. The modeling conducted by North Carolina's modelers show the current impact of TVA's excess emissions as well as the benefits that would result by removing those excess emissions from the atmosphere. (788:7-9)

68. The CMAQ model is precise down to a hundredth of a unit (either a ppb or $\mu g/m^3$). (708:7-24) It is common practice in the field of air quality modeling to report results to a hundredth of a unit. (817:24-818:9) North Carolina's modeling analyzed every day for an entire year and looked at the impacts from emissions on every day on an hourly basis. (785:2-19; 788:10-20) No numerical noise was detected in the model, even when extended out as far as six or seven decimal places. (708:7-17)

69. The current impacts on air quality in North Carolina, Tennessee, Alabama, Kentucky, and throughout the region from TVA's emissions from its coal-fired power plants are very large and substantial (782:21-783:6), and "every individual power plant [in TVA's system] contribute[s] to impacts in North Carolina and throughout the region" (849:14-850:4). The greatest impacts accrue closer to TVA's coal-fired power plants, with lesser impacts at greater distances. (NC Exs. 155, 156; 792:14-793:5; NC Exs. 148, 149; 801:4-21)

70. The emissions caps requested by North Carolina will result in significant reductions in annual average $PM_{2.5}$ levels in North Carolina, Tennessee, Kentucky, and Alabama. (NC Exs. 148, 149) Specifically, the emissions reductions will reduce ambient levels of $PM_{2.5}$ by up to about 0.5 micrograms per meter cubed ("$\mu g/m^3$"). (799:6-21) North Carolina's expert in air quality analysis, Mr. Chinkin, has been hired to advise many areas around the United States on the most effective air pollution control programs (776:22-777:12) and, based on his experience, testified that a half a microgram impact is "huge" and it would typically "take many, many, many control programs of many, many sources to achieve that level of reduction" (806:6-13).

71. The emissions reductions requested by North Carolina will result in significant reductions in peak 8-hour ozone levels in North Carolina, Tennessee, Kentucky, and Alabama. (NC Exs. 155, 156) Specifically, the emissions reductions will result in reductions in 8-hour ozone levels of up to 8 parts per billion ("ppb"). (790:21-791:17; NC Ex. 155) North Carolina's expert in air quality analysis, Mr. Chinkin, has been hired to advise many areas around the United States on the most effective air pollution control programs (776:22-777:12) and, based on his experience, clearly stated that TVA's current impacts on ozone levels in the Southeast, "in comparison to studies [he has] done throughout the country," are "huge impacts" (783:2-6). (*See also* 842:19-23)

72. The natural background level of ozone is 40 ppb and the current federal ambient standard for 8-hour ozone levels is 75 ppb, meaning that EPA has determined that man-made sources may contribute no more than 35 ppb above natural background levels. (791:24-792:4) TVA's emissions alone account for approximately 25% of this interval in areas of the Southeast. (792:5-22)

73. "The benefits for both NO_X and SO_2 controls that we're talking about in this case would be huge. . . . [R]emoving these NO_X and SO_2 emissions from TVA's power plants is equivalent to removing 3.7 million heavy-duty diesel trucks off the road. It's equivalent to

removing 12.8 million passenger vehicles off the road every day." (848:24-849:5)

B. Air Quality Modeling Conducted by TVA:

74. TVA's air quality modeling results corroborate the modeling done by North Carolina's air quality modelers. (480:6-13)

75. TVA's experts show the same air quality impacts that North Carolina's experts calculated using their model. (809:15-810:16)

76. TVA's modeler, Dr. Thomas Tesche, used 2002 emissions inventories to approximate "current" impacts from TVA's, Duke Energy's, Progress Energy's, and others' emissions. (2311:25-2312:10; TVA Ex. 273 at 7) However, modeling using 2002 emissions is not reflective of "current" conditions because it does not include reductions required or already made under the Clean Smokestacks Act in North Carolina. (2311:25-2314:1)

77. The modeling results presented by Dr. Tesche are of limited use because the scales chosen by Dr. Tesche obscure some of the results. (705:9-12)

78. TVA's modeling results show that in 2002, emissions from TVA's plants located in Tennessee impacted annual average $PM_{2.5}$ levels most in Tennessee, but also in Kentucky, Alabama, North Carolina, and throughout the region. (TVA Exs. 290, 291; 2212:16-2213:14) TVA's modeling results further show that emissions from TVA's plants located in Eastern Tennessee and those located in Middle and Western Tennessee contribute to $PM_{2.5}$ pollution in every county in North Carolina. (TVA Ex. 345 at appx.C fig.5-A)

79. TVA's modeling results show that in 2002, emissions from TVA's plants located in Alabama impacted annual average $PM_{2.5}$ levels most in Alabama and Tennessee, but also in Kentucky, North Carolina, and elsewhere in the region. (TVA Exs. 288, 291; 2209:22-2210:16) TVA's modeling results further show that

emissions from TVA's plants located in Alabama contribute to $PM_{2.5}$ pollution in every county in North Carolina. (TVA Ex. 345 at appx.C fig.5-A)

80. TVA's modeling results show that in 2002, emissions from TVA's plants located in Kentucky impacted annual average $PM_{2.5}$ levels most in Kentucky, but also in Tennessee, North Carolina, and elsewhere in the region. (TVA Exs. 289, 291; 2211:19-2212:10) TVA's modeling results further show that emissions from TVA's plants located in Kentucky contribute to $PM_{2.5}$ pollution in every county in North Carolina. (TVA Ex. 345 at appx.C fig.5-A)

81. TVA's modeling results show that in 2002 TVA's emissions contributed to sulfate and nitrate deposition in North Carolina, Tennessee, Alabama, Kentucky, and throughout the region. (TVA Exs. 299, 301, 302, 305)

82. TVA's modeling results show that reducing TVA's emissions from the levels TVA plans to achieve in 2013 to the levels sought by North Carolina for 2013 will result in additional improvements in maximum 8-hour ozone in North Carolina, Tennessee, Kentucky, and Alabama. (TVA Ex. 276)

83. TVA's modeling results show that reducing TVA's emissions from the levels TVA plans to achieve in 2013 to the levels sought by North Carolina for 2013 will result in additional improvements in annual-average $PM_{2.5}$ in North Carolina, Tennessee, Kentucky, and Alabama. (TVA Ex. 317; 2255:14-2258:21)

84. Less weight should be attributed to TVA's 2013 air quality modeling because there were discrepancies between the 2013 emissions estimates made by Mr. Scott, TVA's Senior Strategic Program Manager for its Fossil Power Group (2031:8-11; 2065:6-2066:2), those that Dr. Tesche reported were used to run the air quality model simulations, and those that were actually input into the model simulations. (836:12-840:5; NC Exs. 182, 183; *see also* 2161:7-2162:4)

85. TVA's air quality modeling for 2013 compared the additional improvements to air quality that will accrue from reducing TVA's emissions to the levels sought by North Carolina against the improvements that would result if TVA completes all of the emissions control projects it plans to complete by 2013. (2140:21-2142:9; 2310:5-12) TVA's projected 2013 emissions are unreliable because they are based on TVA's Long Range Plan, which is subject to change, is not legally enforceable, and is based on compliance with current applicable and anticipated future legal requirements, especially the Clean Air Interstate Rule ("CAIR") and the Clean Air Mercury Rule ("CAMR") (1888:1-5; 1895:18-11), both of which have been vacated (2077:9-22; *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008) (vacating CAIR); *New Jersey v. EPA*, 517 F.3d 574 (DC Cir. 2008) (vacating CAMR); *see infra* ¶¶ 276; 287-93).

C. Air Quality Modeling Conducted by EPA:

86. Air quality modeling conducted by EPA in support of the now vacated CAIR is consistent with North Carolina's modeling performed for this case. (813:25-814:17)

87. Air quality modeling performed by EPA establishes that emissions from Tennessee, Alabama, and Kentucky significantly contribute to $PM_{2.5}$ levels in Catawba and Davidson Counties, two North Carolina counties that are currently in non-attainment for the annual average $PM_{2.5}$ standard. (NC Ex. 11 at 00244714, 00244720; NC Ex. 13; 112:4-117:11; 118:6-9) Emissions originating in North Carolina account for less than 20% of the total $PM_{2.5}$ impact on Catawba County and approximately 25% of the total $PM_{2.5}$ impact on Davidson County, with the majority of impacts for both counties coming from out of state, including emissions from Tennessee, Alabama, and Kentucky. (117:12-118:5, NC Ex. 11 at 00244176-18; NC Ex. 13)

88. Air quality modeling conducted by EPA shows that manmade emissions from Tennessee contribute significantly to $PM_{2.5}$ non-

attainment in Catawba and Davidson counties in North Carolina, Knox and Hamilton Counties in Tennessee, Jefferson and Russell counties in Alabama, and Fayette and Jefferson counties in Kentucky. (NC Ex. 11 at NC00244719-21; NC Ex. 13) EPA's air quality modleling also shows that emissions from Tennessee have the greatest impact on the non-attainment areas in Tennessee. (NC Ex. 11 at NC00244719-21)

89. Air quality modeling conducted by EPA shows that manmade emissions from Alabama contribute significantly to $PM_{2.5}$ non-attainment in Catawba and Davidson counties in North Carolina, Knox and Hamilton Counties in Tennessee, Jefferson and Russell counties in Alabama, and Fayette and Jefferson counties in Kentucky. (NC Ex. 11 at NC00244713-15; NC Ex. 13) EPA's air quality modleling also shows that emissions from Alabama have the greatest impact on the non-attainment areas in Alabama. (NC Ex. 11 at NC00244713-15)

90. Air quality modeling conducted by EPA shows that manmade emissions from Kentucky contribute significantly to $PM_{2.5}$ non-attainment in Catawba and Davidson counties in North Carolina, Knox and Hamilton Counties in Tennessee, Jefferson county in Alabama, and Fayette and Jefferson counties in Kentucky. (NC Ex. 11 at NC00244713-15; NC Ex. 13) EPA's air quality modleling also shows that emissions from Kentucky have the greatest impact on the non-attainment areas in Kentucky, with the exception of their impact on Clark, Indiana. (NC Ex. 11 at NC00244713-15)

D. Air Quality Modeling Conducted by the Southern Appalachian Mountains Initiative

91. The modeling performed by the Southern Appalachian Mountains Initiative ("SAMI") is consistent with North Carolina's modeling. (811:17-813:14)

92. SAMI was a ten-year cooperative study from 1992 to 2002 aimed at understanding the impacts from air pollution sources on the

Southern Appalachians, determining what could be done in terms of emissions reductions, and assessing the impact reductions would have on air quality related values in the region. (36:24-37:15, 40:20-41:10)

93. The participants in SAMI were the eight states surrounding the Southern Appalachians (including North Carolina), EPA Regions 3 and 4, the Blue Ridge Parkway, the U.S. Forest Service, and other participants from environmental groups, academia and industry, including TVA. (NC Ex. 1 at ii; 37:4-5; 38:18-40:8; 1842:3-8)

94. TVA was one of the contractors for SAMI. (NC Ex. 1 at iii; 40:11-19; 1842:3-8) TVA's office of general counsel and the environmental affairs group were aware of the SAMI conclusions. (NC Ex. 449 at 100:23-101:14) TVA did not dissent or disagree with the final conclusions of SAMI. (86:13-22)

95. One of SAMI's main conclusions was that emissions reductions generally have the greatest impact locally or within the same state, but also impact neighboring states. (2210:17-2211:13; 1777:5-1778:7; NC Ex. 1 at vii; NC Ex. 3)

96. SAMI modeled emissions reductions on a state-by-state basis to determine the relative benefits of selectively controlling emissions of SO_2 and NO_X in various portions of the region. (60:13-23) SAMI determined that reductions in SO_2 from emissions sources in Tennessee would benefit not only Tennessee, but North Carolina and other states. (64:16-65:3; 66:22-67:6; 68:13-18; 70:1-8; NC Ex. 3 at 2, 6, 14, 28) SAMI found that sulfate aerosol mass at Joyce Kilmer Slickrock Wilderness Area, Shining Rock, and Linville Gorge in North Carolina and at Look Rock in Great Smoky Mountains National Park ("GSMNP") would benefit most from reducing SO_2 emissions in Tennessee. (74:7-77:6; NC Ex. 1 at 3.18 fig.3.11) These same areas also show appreciable benefits from reductions in sulfur dioxide emissions from sources in Alabama and Kentucky. (76:9-16; 77:7-10, NC Ex. 1 at 3.18 fig.3.11)

97. Class I Areas are pristine areas designated by the Clean Air Act as particularly in need of protection. (45:24-46:7) There are four Class I Areas in western North Carolina: Linville Gorge, Shining Rock Wilderness Area, Joyce Kilmer Slickrock Wilderness Area, and GSMNP. (45:6-10)

98. SAMI found that annual average sulfate mass at Sipsey Wilderness Area in northwest Alabama is most influenced by SO_2 emissions from Alabama, and is also impacted by emissions from Tennessee. (NC Ex. 1 at 3.18 fig.3.11)

99. SAMI concluded that "[t]o reduce acid deposition affecting streams in the central and northern part of the SAMI region, it is important to reduce SO_2 emissions." (NC Ex. 1 at ix; *id*. at vii, 10.2; 80:12-21)

100. SAMI also studied the costs of controlling emissions (49:23-50:6), and determined that it is much more cost-effective to reduce utility emissions than emissions from industrial point sources. (57:10-60:2; NC Ex. 1 at 7.11 fig.7.8)

V. Impact on Human Health:

101. Elevated levels of ozone and $PM_{2.5}$ are detrimental to public health. (908:9-938:15; 1036:1-20; 1038:25-1040:4)

102. Epidemiological studies and the scientific literature support the existence of a strong significant linear relationship between adverse health effects and concentrations of $PM_{2.5}$ and ozone. (1075:17-1076:18; 1079:24-1080:23)

103. There is no evidence of a threshold below which no human health effects from exposure to ozone or $PM_{2.5}$ occur. (1075:10-1077:25; 1079:11-1080:23; 949:14-18) Scientific studies have demonstrated health effects down to very low levels. (1075:17-1076:15)

104. In 2006, EPA conducted an expert elicitation by empanelling twelve experts to assess the concentration response function for risk of premature mortality from exposure to $PM_{2.5}$. (NC Ex. 242) Eleven of these twelve experts agreed that the existence of a threshold level below which exposure to $PM_{2.5}$ does not result in increased risk of premature mortality is not consistent with the published literature. The twelfth expert thought there was a 50% chance that there is a threshold, and if there is a threshold for effects from exposure to $PM_{2.5}$ it would most likely be below 5 $\mu g/m^3$. (1078:1-25; 1050:10-1051:9)

105. There is strong scientific evidence of the existence of health effects below the current National Ambient Air Quality Standards ("NAAQS") for $PM_{2.5}$ and ozone. (1076:19-1077:7; 933:24-934:19)

106. "EPA has articulated on many occasions that their NAAQS is not meant to be a zero risk level. When EPA conducts its health impact assessments, it uses concentration response functions and quantifies benefits below the [NAAQS]." (1076:22-1077:4; 62 Fed. Reg. 38,856, 38,857 (July 18, 1997) (the NAAQS are not intended to be a zero-risk threshold); 71 Fed. Reg. 61144, 61145 (Oct. 17, 2006) (same); 71 Fed. Reg. 61144, 61169 (Oct. 17, 2006) (noting the "absence of evidence of any clear effects thresholds")

107. Dr. David Peden is North Carolina's expert in environmental medicine, asthma, toxicology, and the biological effects of air pollution on human health, including mechanisms of adverse cardiovascular and respiratory outcomes. (904:17-21, 906:7-14) Dr. Peden is a practicing physician and researcher at the University of North Carolina (896:17-897:2) and is the Associate Chair for Research for the Department of Pediatrics, the Chief of the Division of Allergy, Immunology, Rheumatology, and Infectious Diseases, and the Director of the Center for Environmental Medicine, Asthma, and Lung Biology (895:20-896:2). Dr. Peden is the principal investigator on a large fraction of the studies conducted at the UNC Center for Environmental Medicine, Asthma, and Lung Biology (901:3-7), which include studies of biological impacts of exposure

to $PM_{2.5}$ and ozone on both cardiovascular and respiratory health (902:19-904:16). Dr. Peden is also associate editor of the Journal of Allergy and Clinical Immunology and reviews a number of journals including the Annals for American College of Allergy, Immunology and the American Journal for Critical Care Medicine, Allergy, and the New England Journal of Medicine. (897:20-898:4) North Carolina's Exhibit 428 is a more complete statement of Dr. Peden's qualifications.

108. Dr. Donald Russell is a practicing physician at Allergy Partners in Asheville, North Carolina (951:1-15; 953:6-9) who specializes in allergy, asthma, and clinical immunology (952:1-5). Dr. Russell treats patients for allergic diseases of the respiratory tract including asthma (953:13-17), approximately sixty percent of whom are affected by poor air quality (973:25-974:7) and approximately five to ten percent of whom have poorly controlled or undercontrolled asthma (974:22-975:3).

A. Adverse Human Health Effects from Exposure to $PM_{2.5}$:

109. Exposure to $PM_{2.5}$ causes respiratory and cardiovascular health problems. (1036:21-1038:24)

110. There are biologically plausible pathways for $PM_{2.5}$ to cause airway inflammation, systemic inflammation, heart rate variability, and vascular reactivity. (915:16-916:23; 932:5-11; 1036:21-1037:6; 1026:9-22) These health effects can lead to premature death or hospitalization. (908:18-909:4; 918:7-10; 1036:21-1037:6)

111. $PM_{2.5}$ exposure is associated with acute exacerbations of cardiovascular disease, including premature death, myocardial infarction, heart rate variability, changes in systemic vascular inflammation, and other vascular diseases. (908:18-909:4; 911:23-913:14; 917:22-918:15; 1036:21-1037:6) Changes in heart rate and cardiac rhythm caused by exposure to $PM_{2.5}$ can lead to increased risk for sudden death or arrhythmia. (913:16-914:13)

112. There is a causal relationship between exposure to $PM_{2.5}$ and premature death, cardiac and respiratory hospitalizations, emergency room visits, asthma exacerbations, development of and acute exacerbation of existing cases of chronic bronchitis, lost school days, and incidence of minor restricted activity days. (936:24-938:15; 909:6-20; 929:3-12; 930:1-24)

113. Exposure to $PM_{2.5}$ can cause premature mortality of individuals who would have otherwise had an undefined life span. (919:10-19)

114. In EPA's recent formal expert elicitation, ten of the twelve participating experts stated that, in their expert opinions, after thorough review of the available literature, they believe there is over a 90% probability that exposure to $PM_{2.5}$ causes premature mortality. (1130:16-1131:15; NC Ex. 242 at viii, 3-23, 3-24)

115. TVA's proffered expert in the field of air pollution epidemiology, Dr. Suresh Moolgavkar (2338:16-24), admits that his opinion that there is not enough evidence to infer a causal relationship between $PM_{2.5}$ and premature mortality conflicts with the opinion of the clear majority of experts' opinions who were involved in EPA's expert elicitation that there is a causal relationship between $PM_{2.5}$ and premature mortality. (2398:8-18)

116. No evidence supports deviating from the assumption recognized by most in the scientific and regulatory community that the various $PM_{2.5}$ constituents have the same toxicity. (1085:20- 1087:7)

B. Adverse Human Health Effects from Exposure to Ozone:

117. "Ozone has been a very well studied pollutant for decades and there's good understanding of its effects on the lungs and the ways in which it can contribute to respiratory deficits." (1040:7-17)

118. Exposure to high ozone concentrations can cause respiratory problems in humans (1238:25-1239:8; 1038:25-1039:17), including increased airway inflammation and decreased respiratory function in

otherwise normal, healthy people (909:21-910:8; 924:4-22; 1239:9-13).

119. TVA has admitted that symptoms of respiratory tract irritation from excessive ozone levels may include breathing difficulties, coughing, and throat irritation, and that recovery from ozone damage to the respiratory system may take several days. (NC Ex. 443 at Resp. No. 17)

120. Exposure to ozone can cause an immediate difficulty and pain in taking a deep breath. (909:21-910:3; 922:9-25)

121. Exposure to high levels of ozone can cause otherwise healthy individuals, including experienced hikers, professional trail guides, and endurance athletes, to have difficulty drawing a deep breath. (1239:14-1240:2; 876:25-877:12; 924:23-926:1; 1337:23-1339:5)

122. The health of people engaging in strenuous aerobic activity like hiking is particularly threatened by breathing air with a high ozone concentration. (1238:25-1239:13; NC Ex. 276 at 2351)

123. On high ozone days employees and volunteers who work outside in the Appalachian Trail National Park are to follow a protocol that requires them to curtail physical activities. (1240:3-16) Similarly, the National Park Service issues advisories to employees in GSMNP when ozone levels are high. (NC Exs. 487, 488; 1241:10-1242:9; 1361:2-25)

124. Chronic exposure to ozone is linked to increased occurrence of lung disease, including asthma and decreased lung function in children. (926:23-928:10)

125. Exposure to ozone causes increases in asthma exacerbation. (909:21-910:8; 919:20-920:8) Asthma exacerbations result in increases in hospitalizations typically 24 to 48 hours after the high ozone events. (920:3-11)

126. After high ozone days in western North Carolina, more asthma patients contact their doctor's office to obtain refills for their asthma medications, including rescue medications used when patients have a flare up of their asthma symptoms. (965:12-966:12; 972:15-973:24) The majority of patients with asthma in western North Carolina are adversely affected by bad air days. (973:25-974:7)

127. Some people who suffer from asthma are extremely sensitive to high levels of ozone and when ozone is high cannot garden, ride a bike, run, jog, or even go to work without having an asthma exacerbation. (960:14-962:6)

128. Some asthma patients in western North Carolina have asthma that is uncontrolled or poorly controlled. (974:22-975:3) If asthma is uncontrolled or poorly controlled, it can cause scarring of the lungs and the patient can permanently lose from 10 to 60 percent of his lung function. (975:4-976:12) Uncontrolled or poorly controlled asthma can be fatal. (976:13-14)

129. There is a causal relationship between exposure to ozone and respiratory hospitalizations, emergency room visits, asthma exacerbations, chronic bronchitis, and lost school days. (936:10-23)

C. Estimates of Quantified Human Health Effects:

130. Developing a health impact assessment is the standard methodology used to understand and quantify the health benefits from pollution emission controls or a change in emissions. It is very reliable, and widely accepted and used by EPA, the European Union, the World Health Organization, as well as within academic literature. (1030:2-1031:4; 1032:25-1033:3; 1015:16-1017:2) EPA used the health impact assessment methodology as early as 1997, including in its regulatory impact assessment of CAIR, which estimated the health benefits that would result from the anticipated reductions of emissions of SO_2 and NO_X from coal-fired power plants. (1031:18-1032:14) In addition, EPA has incorporated the health impact assessment methodology into its software package,

"BenMAP," that has been used by EPA and a number of state agencies. (1031:5-17)

131. Dr. Jonathan Levy, North Carolina's expert in risk analysis and epidemiology (1015:16-18), presented estimates of the number of adverse health effects that are caused by TVA's current excess levels of air emissions, as well as the benefits to public health that will accrue if TVA is required to meet the remedy proposed by North Carolina. Dr. Levy holds an undergraduate degree from Harvard College in applied mathematics and a doctorate in Environmental Science and Risk Management from Harvard (993:8-994:4), with a dissertation focused on quantifying health impacts from emissions from power plants (994:7-995:3). Dr. Levy has published numerous papers studying the impacts of power plant emissions on public health (994:7-998:1) and is currently an Associate Professor at the Harvard School of Public Health (987:21-23). North Carolina's Exhibit 429 is a more complete statement of Dr. Levy's qualifications.

132. Dr. Levy performed a health impact assessment, which is a special case of risk assessment and has been codified as a four step process involving: (1) identification of hazards, (2) exposure assessment, (3) dose response, and (4) risk characterization. (NC Ex. 485; 1023:15-1025:21) These four steps have been defined by the National Research Council since at least 1983. (1023:15-1024:3) This paradigm has been accepted worldwide as the standard approach for risk assessment. (1026:2-4) Dr. Levy relied on the best central estimates and the strongest available data for the inputs to the health impact assessment (1033:4-1034:7; 1059:23-1060:7), which resulted in best central estimates of the public health burden from TVA's excess emissions as well as the best central estimate of the benefits to public health that will accrue if TVA's excess emissions are removed from the system (1067:10-1068:10; 1074:11-1075:2).

133. TVA's proffered expert in toxicology, risk assessment, and integrating sciences for risk assessment, Dr. Elizabeth Anderson

(2419:12-21), did not perform a quantified health-based risk assessment of TVA's emissions (2450:22-2451:20) and did not consider the impacts of TVA's emissions on any state besides North Carolina (2452:2-15).

134. There is strong and systematic evidence that allows for determining concentration response functions for ozone and $PM_{2.5}$. (1026:9-22; 1040:23-1041:4; 1043:17-1045:4)

135. The concentration response functions used by North Carorlina's experts in this case were derived by performing a meta-analysis of the applicable literature. (1121:8-1122:18)

136. The most reasonable best estimate for the concentration response function for premature mortality risk from exposure to $PM_{2.5}$ is a 1 percent increased risk of premature mortality for each additional microgram per cubic meter ("$\mu g/m^3$") of $PM_{2.5}$ to which a person is exposed on an annual basis. (1048:20-1049:1)

137. Part of the purpose of EPA's recent expert elicitation (discussed above), was to "elicit from each expert his best estimate of the true value for an outcome or variable of interest as well as his uncertainty about the true value." (NC Ex. 242 at ii; 1050:10-1051:9) The vast majority of concentration response functions selected by the experts, as well as the concentration response functions calculated by the two major studies for $PM_{2.5}$ mortality, tend to fall roughly between 0.5 and 1.5 percent increase in risk of premature mortality for each additional microgram per cubic meter of $PM_{2.5}$ exposure. (1051:16-1052:23; 1058:18-24; NC Ex. 239) The full body of expert opinions is very close to 1 percent increase in risk per microgram per cubic meter in $PM_{2.5}$ exposure on an annual basis. (*Id.*)

138. The health impact assessment applied in this case yields a reasonable and reliable estimate of the impacts on public health from reducing TVA's emissions of SO_2 and NO_X to the proposed levels. (1074:11-1075:2) It relies on standard practices, utilizes

state-of-the-art atmospheric dispersion modeling to estimate exposure, relies on substantial epidemiologic and corroboratory toxicological literature, and then relies on very standardized population databases in a straightforward calculation. (*Id*.) Each of these steps represents best practices in the field and yields reasonable best estimates of the benefits of controls on TVA's coal-fired power plants. (*Id*.)

139. TVA's current emissions impose a substantial public health burden, causing both mortality and nonfatal illness throughout the modeling domain (1021:10-1022:10; 1090:14-22), which includes all of North Carolina, Tennessee, Alabama, Kentucky, South Carolina, Georgia, Florida, Mississippi, Louisiana, Arkansas, Missouri, Illinois, Indiana, Ohio, West Virginia, Virginia, Maryland, Washington, D.C., Delaware, Pennsylvania, and New Jersey, and portions of Texas, Oklahoma, Kansas, Nebraska, Iowa, Minnesota, Wisconsin, Michigan, New York, and Massachusetts (NC Ex. 135).

140. Reducing ambient levels of $PM_{2.5}$ and ozone decreases the incidence of detrimental health impacts, including the risk of premature mortality, chronic bronchitis, cardiovascular and respiratory effects that result in hospital admissions, asthma attacks and related emergency room visits, as well as minor restricted activity days and lost school days. (1067:10-1068:10; NC Exs. 228, 243)

141. According to North Carolina's health impact assessment, using 2000 population data, the reduction in emissions due to the proposed emissions caps sought by North Carolina (as described by Dr. Staudt and modeled by Messrs. Chinkin and Wheeler) would yield the following health benefits each year in North Carolina, Tennessee, Kentucky, and Alabama:

	North Carolina	Tennessee	Alabama	Kentucky	Total (NC, TN, AL, KY)
Premature Mortalities	99	180	77	91	447
Cardiovascular Hospital Admissions	20	32	14	17	83
Respiratory Hospital Admissions	40	70	31	35	176
Emergency Room Visits for Asthma	57	95	39	47	238
New Cases of Chronic Bronchitis	43	68	29	35	175
Asthma Exacerbations	19,000	30,000	13,000	15,000	77,000
Minor Restricted Activity Days	47,000	82,000	33,000	39,000	201,000
Lost School Days	2,300	7,200	2,700	3,500	15,700

(1069:5-1071:4; 1071:14-1072:1; NC Exs. 231, 233, 234, 235, 236, 237)

142. Reductions of TVA's SO_2 and NO_X emissions to the levels sought by North Carolina will result in the following reductions in mortality and illness in the modeled region (as represented by the blue rectangle shown in NC Ex. 135):

Health Outcome	Number of reduced incidences in modeled region using 2000 population:	Number of reduced incidences in modeled region using 2013 population:
Premature Mortalities	1400	1600
Cardiovascular Hospital Admissions	290	360
Respiratory Hospital Admissions	560	620
Emergency Room Visits for Asthma	870	980
New Cases of Chronic Bronchitis	580	670
Asthma Exacerbations	250,000	290,000
Minor Restricted Activity Days	630,000	710,000
Lost School Days	42,000	43,000

(NC Exs. 228, 243; 1067:10-25; 1063:19-1064:7; 1068:1-10)

143. The quantified health benefits estimated by Dr. Levy will accrue in each year that TVA's emissions are reduced to the levels sought by North Carolina and will increase each year as the population grows. (1070:20-1071:4)

VI. Monetary Value of Estimated Adverse Human Health Effects:

144. Dr. Leland Deck, North Carolina's expert on economic analysis of air pollution controls (1161:3-8), quantified the monetary value of the benefits to public health estimated by Dr. Levy and compared those monetized benefits to the annualized cost of the proposed control scenario (1162:3-1165:5). Dr. Deck has been involved in the field of economic cost-benefit analysis of air quality policy and analysis since 1981. (1150:3-17; 1153:13-1154:2) Dr. Deck holds both a masters degree and a Ph.D. from the University of Maryland in Economics. (1150:24-1151:4) Dr. Deck has held positions with the State of Maryland and U.S. EPA (1151:5-1153:9), and is currently a managing economist at Stratus Consulting (1149:13-15). Dr. Deck has also published many economic analyses of air pollution controls on coal-fired power plants in the past (1158:15-1160:13), routinely peer-reviews articles and is a member of the American Economics Association, the Association of Environmental Resource Economics and Waste Management Association, and the Society for Risk Management, and was also a peer-reviewer of a book published by the National Research Counsel on risk assessment methods (1160:14-1161:2). North Carolina's Exhibit 434 is a more complete statement of Dr. Deck's qualifications.

145. The values used by Dr. Deck have been subject to an extensive peer review process, have been approved by the EPA Science Advisory Board and the National Academies, and have been vetted through the public comment process. (1175:3-13; 1176:10-24; 1206:20-22) The values used are the generally accepted standard values for analyzing the cost of health effects and represent the best current central values. (1176: 10-13; 1211:17-1212:2)

146. Using the population in 2000 and considering only those health benefits quantified by Dr. Levy, Dr. Deck calculated that the benefits that will accrue in North Carolina alone in association with the emissions reductions sought by North Carolina will be at least $672 million per year. (1177:14-1179:5; NC Ex. 384)

147. The estimated annual public health benefits (using 2000 population) associated with the additional controls sought by North Carolina are $1.17 billion in Tennessee, $672 million in North Carolina, $610 million in Kentucky and $519 million in Alabama. (NC Ex. 386; 1181:9-19) The total annual public health benefits for these four states (using 2000 population) amount to $2,973,400,000. (NC Ex. 386)

148. The monetary value of these benefits will increase as the population grows. (1162:7-15) For example, the benefits accruing to North Carolina using the 2013 forecasted population is $792 million per year. (1180:18-1181:4; NC Ex. 385) The benefits accruing to the entire region associated with the additional controls sought by North Carolina (using the forecasted 2013 population) amount to $10.9 billion per year. (1180:18-1181:4; NC Ex. 385)

149. The estimated total health benefits per year by state associated with the additional controls sought by North Carolina (using 2013 population) are $1.37 billion in Tennessee, $792 million in North Carolina, $693 million in Kentucky and $587 million in Alabama. (NC Ex. 387; 1182:7-13) The total annual public health benefits per year for these four states (using 2013 population) amount to $3,439,600,000. (NC Ex. 387)

150. From an economic standpoint, including all of the benefits that were calculated is important information to present to any decision-maker. (1183:7-1184:8) No theory or principle of economic analysis suggests that evaluation of benefits should be limited to benefits only in North Carolina in this type of air pollution control program analysis. (1199:2-19)

151. The estimated total health benefits per year for the entire modeled region associated with the additional controls sought by North Carolina (using 2000 population) are $9.50 billion. (NC Ex. 384) The total benefits per year for the modeled region (using 2013 population) are $10.86 billion. (NC Ex. 385)

A. Benefit-Cost Analysis:

152. Using capital and operation and maintenance costs estimated by North Carolina's expert Dr. Staudt, Dr. Deck estimated that the annualized cost of the proposed remedy would be $516 million per year. (1190:15-1191:22) TVA's employee Michael Scott estimated a cost of $718 million annually. (1190:24-1192:8; 1194:11-18; NC Ex. 390)

153. TVA's witness Dr. Anne Smith separated the annualized cost of the proposed remedy by project, which shows that the estimated annualized cost would be approximately $317 million for proposed projects in Tennessee, $121 million for proposed projects in Alabama, and $78 million for proposed projects in Kentucky. (TVA Ex. 438 at 86 tab.F-1; 2788:17-2789:10)

154. The quantified health benefits in each state, North Carolina, Tennessee, Kentucky, and Alabama, far exceed the annualized cost of the proposed projects in that state. The benefits accruing in any one of these states outweigh the annualized cost of the entire remedy for all of TVA's system. In addition, the quantified health benefits to this four-state area far exceed the costs of the proposed remedy.

	Annual Cost Based on NC's $3b Cost Estimate (from TVA Ex. 438 at 86 tab.F-1)	Annual Cost Based on TVA's $5b Cost Estimate (from TVA Ex. 438 at 87 tab.F-2)	Annual Quantified Health Benefits (2000 population) (from NC Ex. 386)	Annual Quantified Health Benefits (2013 population) (from NC Ex. 387)
NC	N/A	N/A	$672 million	$792 million
TN	$317 million	$436 million	$1.17 billion	$1.37 billion
KY	$121 million	$145 million	$610 million	$693 million
AL	$78 million	$120 million	$519 million	$587 million
Total	**$516 million**	**$703 million**	**$2.97 billion**	**$3.44 billion**

155. The reduction of TVA's costs due to fuel savings are not accounted for in North Carolina's benefit-cost analysis, meaning that the benefit-cost ratios calculated in North Carolina's Exhibit 390 are underestimates. (1194:11-1195:11)

B. Health Care Costs Incurred Directly By the State of North Carolina:

156. Total Medicaid costs in North Carolina for direct health care services were $8.2 billion in fiscal year 2005, of which North Carolina paid $2.6 billion and counties in North Carolina paid another $427 million. (1196:16-1198:20) North Carolina's Medicaid expenditures for cardiovascular and respiratory hospitalizations and emergency room visits, for treatment of chronic bronchitis and for asthma treatment drugs in fiscal year 2006 totaled over $82 million. (NC Ex. 45 at 1, 6) As the demand or the need for heath care goes down, the expenditures on heath care by the State will decrease. (1197:3-9)

157. In western North Carolina, the cost of medication to treat an individual with asthma is $200-$800 a month, depending on the severity of the patient's asthma. (965:8-13)

158. Some people who suffer from asthma in western North Carolina cannot control their asthma through medication and must go to the hospital. (963:7-20) Emergency room visits in the Ashville area hospitals for asthma begin at $1,300 to $1,500; if the patient is admitted to the hospital, the average cost is a minimum of $5,000. (963:21-25)

159. North Carolina through its Medicaid program spent $82,066,347 on asthma medication in 2006 and $69,965,538 in 2007. (NC Ex. 45 at 6; 970:13-980:17)

VII. Environmental Impacts Not Included in North Carolina's Benefit-Cost Analysis:

160. The benefit-cost analysis conducted by Dr. Deck included only the estimated monetized public health benefits. (1184:15-1185:6; NC Ex. 388; NC Ex. 389) The non-monetized benefits stemming from reductions in TVA's NO_X, SO_2, and mercury emissions include unquantified public health impacts, visibility impacts, damage to ecosystems, and impacts on recreation. (1185:9-1188:17; NC Ex. 389)

161. Ozone and $PM_{2.5}$ formed from emissions from TVA's power plants currently significantly impact a number of sensitive resource areas in eastern Tennessee and western North Carolina, including GSMNP, Grandfather Mountain, Linville Gorge, Mount Mitchell, the Biltmore Estate, the Pisgah National Forest, Joyce Kilmer Slickrock Wilderness Area, Cherokee National Forest, Gorges State Park, Shining Rock Wilderness Area, the Blue Ridge Parkway, the Appalachian Trail, and many others. (795:15-799:5; 803:4-805:15; NC Ex. 156; NC Ex. 149)

162. GSMNP and Grandfather Mountain are unique resources that have been accepted by the United Nations as biosphere reserves because of the number of rare species of plants and animals in those locations. (796:12-797:2)

163. TVA has admitted that air quality "is an environmental resource value that is considered important to most people." (NC Ex. 443 at Resp. No. 30)

A. Impacts of Ozone Pollution:

164. Harms associated with ozone are evident at important parks and attractions in North Carolina such as the Appalachian Trail (1238:21-1240:16), GSMNP (1337:8-1339:18), and the Biltmore Estate (1323:14-1324:24).

165. "[G]round level ozone at sufficiently high concentrations can damage plants and sensitive ecosystems, and lower crop and forest productivity." (NC Ex. 443 at Resp. No. 16; *see also* NC Ex. 1 at 5.3) Ozone injures the leaves of vegetation along the Appalachian Trail and in GSMNP by causing black areas of discoloration. (1242:10-1243:2; NC Ex. 276 at 8; NC Ex. 176 at 39)

166. Ozone pollution is a critical problem at GSMNP. (NC Ex. 174; 828:16-829:11) The National Park Service has determined that GSMNP has the greatest ozone impact of any location in the United States east of the Rocky Mountains other than the city of Atlanta, Georgia. (NC Ex. 176 at 39; 826:17-827:17)

167. The National Park Service issues advisories to employees at GSMNP on high ozone days alerting them to forecasted ozone levels and encouraging staff to "refrain from strenuous or prolonged physical outdoor activities." (NC Ex. 488; 1361:2-25; *see also* NC Ex. 487; 1241:10-1242:9)

168. Ozone levels affect operation of the Biltmore Estate. The Biltmore Estate gives its outdoor staff more frequent breaks during ozone alert days. (1323:14-1324:24) The Biltmore also implements specific measures, including not fueling vehicles in the middle of the day, delaying or postponing mowing, and delaying or postponing any work with tractors, weed-eaters or leaf blowers, to be responsible corporate citizens and try to reduce the intensity of ozone alert days. (1323:14-1324:15)

B. Impacts of Reduced Visibility:

169. TVA has admitted that "visibility is a very important value in appreciating wilderness." (NC Ex. 443 at Resp. No. 32) "People value good visibility within the area where they live . . . and in recreational areas . . . ." (NC Ex. 1 at 8.1)

170. Many parks and attractions in North Carolina are tourist destinations because of their mountain views and scenery including

Chimney Rock (1301:6-15), Grandfather Mountain (1758:16-23), the Biltmore Estate (1321:14-23; 1323:4-13), the Appalachian Trail (1243:8-14), the Blue Ridge Parkway (1271:11-22), and GSMNP (1339:19-1340:7).

171. Consistently over the years visitors to the National Forests have reported that one of the reasons they visit the National Forests is to enjoy the views and scenery. (191:20-192:9) The U.S. Forest Service monitors fine particles in the atmosphere at various locations including Shining Rock Wilderness Area (192:10-17), Joyce Kilmer Slickrock Wilderness Area, and Linville Gorge (193:23-194:2), because of the importance of visibility to the public's enjoyment of views and scenery at these areas (191:20-192:12).

172. SO_2 emissions contribute to reduced visibility, (1382:21-1383:2; NC Ex. 443 at Resp. No. 5), and visibility reductions in the Southeast are dominated by sulfates, which are formed from SO_2 in the atmosphere. (191:20-194:9; 194:25-195:6; 1380:12-23) Coal-fired power plants are the dominant source of SO_2 emissions in the Southeast. (191:20-192:25; 1380:17-19; 1385: 1-13)

173. TVA's current emissions have long-range effects on visibility throughout the region, up to 200-300 miles downwind of its plants. (1408:22-1409:3) The emissions caps sought by North Carolina will improve visibility in North Carolina, Tennessee, Alabama, Kentucky, and throughout the region. (1409:4-1410:2)

174. SAMI concluded that the way to make the greatest improvements in visibility would be to make reductions in SO_2 emissions. (NC Ex. 1 at vii, ix, 4.13, 4.20, 10.1; 203:12-17)

175. Haze sometimes obscures long range and panoramic views at Grandfather Mountain (1761:20-1762:12) and diminishes visibility at Chimney Rock (1300:4-1301:5; 1304:16-21), detracting from the awe and sense of wonder that visitors experience from the panoramic views (1768:2-1769:7). Haze also impairs visibility at

other North Carolina's parks and attractions such as the Appalachian Trail (1244:7-17), GSMNP (1339:19-1340:7; 824:1-825:9; NC Ex. 176), and the Biltmore Estate (1323:4-13; 1331:12-20).

176. The Appalachian Trail, a unit of the National Park Service, includes portions running through western North Carolina and then following the North Carolina-Tennessee border through GSMNP. (1234:22-1235:18; NC Exs. 136, 137) Scenery and good views are fundamental to the Appalachian Trail as a National Scenic Trail. (1243:8-14; 1246:9-12) The main reason that people visit the Appalachian Trail is to enjoy the views. (1243:8-14) In fact, enjoying the view and scenery was the most frequently reported activity of visitors to the Appalachian Trail, with 81.9% of visitors engaging in this activity in a 1999 survey. (1249:10-1251:13; NC Ex. 275 at 17)

177. Poor visibility interferes with viewing scenery from the Appalachian Trail. (1252:1-8) On numerous occasions haze is an issue in the Smoky Mountains, where visibility "on a good day ought to be around 80 miles, and can get down to as little as 15 [miles] or less because of haze." (1244:7-17)

178. "The Blue Ridge Parkway . . . is a linear national park extending 469 miles from Shenandoah National Park in Virginia to Great Smoky Mountains National Park in North Carolina. The park is a scenic motor road that was designated by landscape architects to enable visitors to enjoy the scenic beauty of the region primarily from their vehicle . . . . [T]he primary reason most visitors make a trip to the Parkway is to enjoy the views." (NC Ex. 280 at 3)

179. The Blue Ridge Parkway Scenic Experience Project determined that visitors to the North Carolina portion of the Blue Ridge Parkway would be willing to pay, on average, an additional $328 in federal income taxes in order to improve visibility in the northern North Carolina section of the Blue Ridge Parkway. (1271:11-22) When aggregated for the number of visitors to the Blue Ridge

Parkway in North Carolina, the value of increased visibility to these park visitors is $760 million each year. (1271:23-1273:16)

180. SAMI determined that both visitors to and residents of the Southern Appalachian Mountains Region place a high value on improving visibility there. (81:3-85:24; NC Ex. 1 at 8.5-8.6)

181. The SAMI Final Report summarizes SAMI's findings that the various SAMI control scenarios would result in residential visibility benefits valued at $224 million to just over $1 billion, depending on the range of visibility improvement by year 2010, and $1.46 billion for the most stringent strategy by 2040. (82:22-83:23; NC Ex 1 at 8.6 tab.8.6)

182. SAMI found that to improve visibility at Class I areas such as Joyce Kilmer Slickrock Wilderness Area, Look Rock, GSMNP, Shining Rock and Linville Gorge, reductions in sulfur dioxide emissions from Tennessee must occur. (203:23-204:15) TVA accounts for over 70% of the SO_2 emissions in Tennessee. (811:17-812:1; 77:15-18)

183. Mr. John Molenar, North Carolina's expert in air pollution effects on visibility (1375:18-22), used the air quality modeling results generated by Messrs. Wheeler and Chinkin to determine the level of improvements in visibility associated with the remedy proposed by North Carolina (1366:12-23). Mr. Molenar has a master's degree in atmospheric physics and his major research field is in visibility and atmospheric optical measurements. (1366:23-1367:1) Mr. Molenar is vice president of Air Resource Specialists ("ARS"), and is responsible for the atmospheric visibility division. (1365:24-1366:11) Mr. Molenar has personally worked for all of the regional planning organizations in the United States on issues concerning visibility and has worked with the National Park Service on visibility in the National Parks for 26 years. (1368:9-1369:12) In fact, ARS is responsible for the nationwide network of visibility monitors for the National Park Service and other Federal Land Managers. (1369:18-1371:21) Mr. Molenar developed WinHaze –

the visual air quality model he used to generate North Carolina's Exhibits 296, 297, 298, 300, and 301 – under contracts with the National Park Service (1371:22-1374:10). North Carolina's Exhibit 431 is a more complete statement of Mr. Molenar's qualifications.

184. A 1 deciview improvement in visibility represents a perceivable improvement in visibility. (1388:5-1390:5; 695:11-696:8; NC Ex. 1 at 4.3-4.4) The deciview was developed by the Federal Land Managers as a method for quantifying a perceivable change in visibility by performing comprehensive studies involving thousands of participants. (1411:18-1415:5) There is a significant probability that a normal person will detect a 1 deciview change and research indicates that a significant fraction of viewers will perceive a 0.5 deciview change in visibility. (1414:9-25)

185. Reductions in TVA's emissions sought by North Carolina will result in significant improvements in visual range at Class I Areas in Tennessee, North Carolina, and throughout the region (1409:4-1410:25), including at Shining Rock Wilderness Area, Linville Gorge Wilderness Area, Joyce Kilmer Slickrock Wilderness Area, and GSMNP (1396:5-19; NC Ex. 303). Moreover, there will be at least 40 days of perceivable visibility improvements at North Carolina State Parks including Mount Mitchell and Gorges State Park, as well as Look Rock in Tennessee. (1397:1-24) There will also be perceivable improvements in visibility at North Carolina's Mount Jefferson State Park, Stone Mountain State Park, and South Mountains State Park. (NC Ex. 473A)

186. The visual range at Shining Rock Wilderness Area in North Carolina would more than double (on the day with the greatest visibility improvement) as a result of the emissions reductions from TVA's power plants sought by North Carolina. (NC Ex. 160) The visual range at GSMNP would improve by up to 68%, the visual range at Linville Gorge Wilderness Area in North Carolina would improve by up to 74%, and the visual range at Joyce Kilmer Slickrock Wilderness Area in North Carolina would improve by up to 51%. (NC Ex. 160)

187. TVA's visibility expert Ivar Tombach agrees that, *if* TVA puts on all of the controls it plans to by 2013, TVA's impact on visibility impairment in the Southeast will be significantly reduced. (2534:21-25) He also agrees that the more controls that are placed on TVA's coal-fired power plants, the more visibility improvements will be seen in the areas overlain by the plumes from those plants. (2533:21-2534:1)

188. Mammoth Cave National Park, a Class I Area in western Kentucky, is the haziest of the Class I National Parks that are managed by the National Park Service. (NC Ex. 276 at 14 tab.2.3; 1347:1-8; 1354:13-1355:1; 1391:11-19; 1958:15-18) The majority of visitors to Mammoth Cave enjoy its 70 miles of trails and scenic overlooks of the Green River, rather than venturing underground. (1355:2-12) Improvements in visibility resulting from the emissions reductions sought by North Carolina from TVA plants are expected at Mammoth Cave. (1390:6-1391:19)

189. Mr. Molenar, North Carolina's expert in air pollution effects on visibility (1375:18-22), has worked closely with the National Park Service for 26 years (1368:9-1369:12), as well as with the other Federal Land Managers (1369:18-1371:21). Mr. Molenar testified that he was amazed that the improvements in visual air quality resulting from the emissions reductions sought by North Carolina "were this large" and that 18-20 days of perceivable visibility improvements from controlling one set of plants is quite large. (1390:6-21)

C. Impacts of Acid Deposition:

190. Dr. Charles Driscoll, North Carolina's expert in environmental engineering with a concentration in air pollution effects on ecosystems (1445:4-18), evaluated the state of ecosystems in the Southeast and analyzed TVA's contribution to acid deposition and mercury deposition to those sensitive ecosystems (1446:5-16). Dr. Driscoll holds a bachelor's degree, master's degree, and a Ph.D. in

environmental engineering with his dissertation analyzing the mobilization of toxic aluminum by acid rain and the impact on fish from that aluminum. (1448:25-1449:15) Dr. Driscoll is a professor of environmental systems engineering at Syracuse University (1444:1-3), and serves on the Board of Directors of the Upstate Freshwater Institute and the Hubbard Brook Research Foundation, both of which are involved in issues concerning nutrient cycling and impacts on ecosystems (1451:23-1452:18). Dr. Driscoll has completed approximately 80 funded research projects (1454:13-17), has published over 300 articles in peer-reviewed scientific journals (1454:18-1455:10), and has been designated a Highly Cited Researcher in environmental science and in engineering (1457:7-24). Over two-thirds of this work has been focused on air pollution effects on ecosystems. (1452:19-1453:12, 1454:13-17) Dr. Driscoll also has served on committees of the National Academy and National Research Council (1456:3-23) and has testified before the U.S. Senate and House committees on air pollution (1456:24-1457:6). North Carolina's Exhibit 432 is a more complete statement of Dr. Driscoll's qualifications.

191. Acid deposition is the deposition of sulfate and nitrate to ecosystems from the atmosphere through dry, wet, and cloud deposition. (211:9-23; 1464:7-1465:13; *see also* NC Ex. 1 at 6.1) Reductions in SO_2 emissions result in decreases in sulfate deposition, (1474:16-1475:24; 2621:10-21; 2623:18-2624:3; *see also* NC Ex. 1 at 6.2) and reductions in NO_X emissions result in decreases in nitrate deposition (1474:16-1476:15).

192. Acid deposition "can damage some buildings, materials, agricultural crops, and forest species." (NC Ex. 443 at Resp. No. 12)

193. Sulfate deposited to the ground will remove magnesium, calcium, and potassium – nutrients essential for tree growth – from the soil. (212:25-215:14; 216:3-13) Sulfate deposited to the ground also mobilizes aluminum, which is toxic to trees and other organisms. (212:25:213:25)

194. High elevation soils in the Southeast are particularly sensitive to acid deposition (1464:7-1465:13; 1473:7-1474:15; *see also* NC Ex. 1 at viii), which stresses forest vegetation, acidifies lakes and streams, and harms fish and other aquatic life (1486:12-24; 1491:25-1492:12; 1494:13-1496:17; 1498:25-1499:19; 1503:2-1504:13; 1509:11-1510:21). "[A]t sufficiently high concentrations, acid deposition has been shown to destroy fish and other forms of fresh- and coastal-water life." (NC Ex. 443 at Resp. No. 13)

195. Ecosystems throughout the Southeast have been impacted by increased toxic aluminum mobilization from acid deposition. (1491:25-1492:12; 1494:13-1495:11; 1498:16-24; 1503:2-1504:8; 1510:22-1511:6 *see also* NC Ex. 1 at 6.4) In particular, very high concentrations of aluminum in the soil and water have been detected in GSMNP (1492:22-1494:3) and at Linville Gorge (217:17-218:11).

196. Acid deposition degrades surface water quality by lowering pH, decreasing the acid neutralizing capacity, and increasing dissolved inorganic aluminum concentrations. (218:17-13; *see also* NC Ex. 1 at 6.4) Surface waters in North Carolina and the Southeast region exhibit chronic and short term acidification. (1500:5-1501:5; 1501:6-14) Short term episodic acidification follows storms or other events resulting in increased runoff, which is especially harmful to fish and other aquatic organisms. (1511:10-1512:8)

197. Five percent of streams sampled by the U.S. Forest Service in North Carolina, Tennessee, and South Carolina are chronically acidic (1500:5-25) and another 49% are considered to be sensitive to acid deposition (1501:1-1502:3). The National Park Service has found that 59% of the streams in GSMNP are sensitive to acid deposition. (1502:4-8)

198. North Carolina, Tennessee, Alabama, and Kentucky receive among the highest inputs of acid deposition in North America. (1458:15-1549:1; 1465:18-1466:21) TVA contributes to sulfate and nitrate deposition at GSMNP, which receives the highest levels of

acid deposition of any monitored National Park (NC Ex. 176 at 37; 1470:25-1473:6; 1473:7-1474:15; 2614:20-2615:4), and rainfall at the Park is 5-10 times more acidic than natural rainfall (NC Ex. 176 at 37; 2615:5-10).

199. Acid deposition has contributed to stress and poor health of red spruce in North Carolina and the southeastern United States. (1494:13-21; 1497:23-1498:15) Recent studies of high elevation spruce fir forests have shown high levels of tree mortality, decreases in crown condition, and declining growth rates for both spruce and fir populations. (NC Ex. 276 at 36; 1496:18-1498:25)

200. If acid deposition continues at the current rate in the Southeast, important nutrient cations will continue to be lost, more systems will become acidic, incidences of aluminum toxicity will increase, and most streams and watersheds will continue to lose their capacity to neutralize further acid inputs. (234:14-236:7)

201. Critical loads are defined as the level of pollutants below which there are no adverse ecological effects. (1482:2-1483:22) An analysis of critical loads in GSMNP, which was conducted by the U.S. Forest Service on behalf of TVA, shows acid deposition must be reduced by approximately half in order for the ecosystems at GSMNP to recover. (1514:7-1516:10; NC Ex. 494) TVA's expert on acidification of ecosystems, Dr. David Grigal, did not consider this study of critical loads in GSMNP in reaching his conclusions. (2627:5-2628:6)

202. TVA's current emissions have a very large impact on acid deposition in the region. (1477:22-1478:4; 1478:23-1479:5) Acid deposition is continuing to acidify and damage ecosystems in the Southeast, and substantial emissions decreases are necessary for those ecosystems to recover (1558:16-1559:14).

203. TVA's own modeling shows that its emissions contribute to acid deposition at all sites considered. (2621:5-9; TVA Ex. 415) In particular, TVA's modeling shows that in 2002 TVA's emissions

contributed over 15% of the acid deposition at the GSMNP site (2632:6-9; TVA Ex. 415) and about 18% of the acid deposition at the selected site in Kentucky (Lilly Cornett). (2575:15-2576:15; TVA Ex. 415)

204. TVA was aware of the problem of acid deposition in the late 1970s and early 1980s, but spent virtually no money to address its contribution to the problem until the Clean Air Act Acid Rain Program required TVA to install SO_2 reduction equipment. (2829:17-2830:10, 2830:23-2831:5; 1884:4-15; 1885:13-20; 1967: 6-18)

205. North Carolina's witness Mr. William Jackson is an air resource specialist with the U.S. Forest Service in the Department of Agriculture (179:6-11; NC Ex. 440) and holds Bachelor of Science degrees in both biology and forestry (179:1-5). In his capacity as an air resource specialist, Mr. Jackson advises the federal land manager on whether sources of air pollution will cause impacts to any air-quality related values at federally designated Class I areas and conducts the inventory and monitoring of air-quality related values at Class I areas in North Carolina and Tennessee. (181:13-182:19) Mr. Jackson testified that TVA must reduce its SO_2 emissions in Tennessee, Alabama and Kentucky to achieve visibility and acid deposition improvements in the Southern Appalachians. (238:12-22)

206. Reducing TVA's emissions to the levels sought by the State of North Carolina would result in substantial reductions in acid deposition, soil acidification and associated surface water acidification. (1458:15-1459:1; 1477:3-21; 1514:7-24)

207. Reducing TVA's SO_2 emissions to the levels requested by North Carolina would reduce sulfate deposition throughout the region, including by 24% at Walker Branch in Tennessee; 8.4% at Mount Mitchell; 11% at GSMNP; and 3.1% in northern Virginia. (1458:15-1459:4; 1480:2-22; 1526:23-1527:13; NC Ex. 336) The greatest improvements in sulfur deposition as a result of reduced

emissions from TVA are within the areas immediately surrounding the TVA facilities in the states of Alabama, Tennessee, and Kentucky, as well as in North Carolina. (1477:3-21) These reductions in sulfate deposition from reduced emissions suggest that TVA's current excess emissions are having a very large current impact. (1477:22-1478:4)

208. Reducing TVA's NO_X emissions to the levels requested by North Carolina would reduce nitrate deposition throughout the region, including by 1.9% at Walker Branch, 1.2% at Mount Mitchell, 1.2% at GSMNP, and 0.3% in northern Virginia. (1458:15-1459:8; 1480:2-1481:6; 1526:23-1527:13; NC Ex. 336) The greatest improvements in nitrate deposition as a result of reduced emissions are focused around TVA's facilities in the states of Tennessee, Alabama, and Kentucky, as well as North Carolina. (1478:5-22; NC Ex. 334) These numbers may actually underestimate the improvements because North Carolina's projections for TVA's expected 2013 "Base Case" NO_X emissions may be too low. (*See supra* ¶ 23)

E. Impacts of Mercury Deposition:

209. Electric utilities are the largest unregulated source of mercury in the United States. (1521:5-11)

210. Mercury from TVA's excess emissions is currently being deposited in Kentucky, Tennessee, Alabama, and North Carolina. (1526:1-4)

211. SCRs oxidize mercury; mercury emissions from a power plant equipped with an SCR but not a scrubber are almost entirely in the form of oxidized mercury. (417:12-419:14) Installation of a scrubber in addition to an SCR substantially reduces total mercury emissions and nearly eliminates emission of oxidized mercury. (332:2-337:10; 383:21-384:2)

212. Over 90% of the mercury emitted by TVA at its Bull Run and Kingston plants is in the form of oxidized mercury (416:16-420:6; NC Ex. 103), which is generally deposited locally or regionally (1516:13-1518:11; NC Ex. 489).

213. Once mercury is emitted and deposited to soils or waters, it is converted by bacteria into a form that can be absorbed by plant and animal tissues. (1516:13-1519:9) Mercury levels then bioaccumulate and biomagnify in the food chain, reaching toxic levels at the top of the food chain. (1519:10-1520:3; NC Ex. 443 at Resp. Nos. 21-22)

214. Mercury is toxic to humans. (1519:17-1520:3; 1535:10-16) The State of North Carolina currently has advisories on eight surface freshwaters for consumption of Largemouth Bass and Chain Pickerel and general advisories on coastal waters for consumption of Bowfin and King Mackerel due to mercury contamination. (1520:19-1521:4; NC Ex. 48) Tennessee, Alabama, and Kentucky also currently have consumption advisories for mercury. (1520:19-21, 1523:8-1524:8)

215. The control strategy proposed by Dr. Staudt would result in a reduction in TVA's mercury emissions of 1,584 pounds per year – a 54.3% reduction (384:8-387:4; NC Exs. 53, 55) – resulting in reductions in mercury deposition in North Carolina, Tennessee, Kentucky, Alabama, and throughout the region (1526:1-8), including significant reductions close to several of TVA's facilities, including Bull Run and Kingston (1524:13-1525:15).

VIII. Impacts on Tourism Not Included in North Carolina's Benefit-Cost Analysis:

216. Tourism is an important economic driver in North Carolina and thrives upon the natural, scenic beauty of the State. (1742:22-1743:15) Visitors come to North Carolina to experience rest and relaxation in a setting of natural scenic beauty. (1738:16-1739:9; 1739:22-1740:9; 1741:23-1742:8)

217. Visitors to North Carolina contribute $16.6 billion into the State's economy and generate about $1.3 billion in state and local tax revenues. (1743:9-15)

218. A little more than half of GSMNP is located in North Carolina. (45:11-14) TVA has acknowledged that "[n]early ten million people visit the [GSMNP] annually, in part, for the panoramic mountain-top views. However, visitors sometimes cannot fully appreciate these views because of regional haze." (NC Ex. 443 at Resp. No. 34)

219. Recreational and scenic areas in North Carolina such as the Blue Ridge Parkway, GSMNP, State Parks like Mt. Mitchell, privately owned areas like Grandfather Mountain, and the Mountains to Sea Trail from Clingman's Dome to the coast are all at risk from emissions from coal-fired power plants. (1776:15-1777:4)

220. Good visibility in scenic areas in North Carolina has significant economic benefits in addition to its aesthetic value. (NC Ex. 176 at 36) A National Park Service study shows that the number one reason people come to the parks is to see the scenic views. (1352:10-12) For guides leading backpacking trips in GSMNP, tips received on good visibility days are over twice what is received on poor visibility days. (1340:8-25)

A. Impact on the Biltmore Estate:

221. The Biltmore Estate in Asheville, North Carolina welcomes more than one million visitors each year. (1312:22-1313:14) It includes the largest privately-owned residence in the United States and 8,000 acres of land including 475 acres of formal gardens, 93 acres of vineyard, and woodland trails. (1312:14-25; 1319:10-23; 1320:12-1321:10)

222. The primary reason that visitors come to the Asheville area is the scenic beauty of the area and to enjoy the mountain views. (1313:15-1314:14)

223. Air pollution harms the Biltmore Estate by threatening the health of its visitors, employees, and livestock, and by threatening the Biltmore Estate's buildings and grounds themselves. (1323:14-1328:10)

224. Air quality is a concern for the Biltmore Estate when the view of Mount Pisgah, which is approximately 17 miles away, is obscured because visitors complain that they are unable to see the mountains. (1321:11-23; 1323:4-13; 1330:23-1331:23) On bad air quality days, the haze diminishes visibility to approximately 3 miles. (1331:12-20)

225. The copper gutters and roof lines on the Biltmore House have been affected by acid rain, and the Biltmore Estate pays approximately $25,000-$30,000 each year on upkeep of those gutters to ensure no water gets inside the Biltmore House. (1326:19-1328:3) Acid rain also etches and discolors the limestone facade of the Biltmore House. (1328:4-22)

226. TVA's excess air emissions currently contribute an annual average of 0.2-0.3 $\mu g/m^3$ $PM_{2.5}$ to air quality at the Biltmore Estate; the remedy sought by North Carolina will reduce annual average $PM_{2.5}$ concentrations at the Biltmore Estate by 0.2-0.3 $\mu g/m^3$. (NC Ex. 149)

227. TVA's excess air emissions currently contribute 2-4 ppb to maximum 8-hour ozone levels at the Biltmore Estate; the remedy sought by North Carolina will reduce maximum 8-hour ozone concentrations at the Biltmore Estate by 2-4 ppb. (NC Ex. 156; 798:20-23)

228. The remedy sought by North Carolina will result in more than 40 days of perceivable visibility improvement each year at the Biltmore Estate. (NC Ex. 303, 137)

B. Impact on Outdoor Recreation:

229. A Walk in the Woods is a guide service based in Gatlinburg, Tennessee that leads interpretive walks, including short walks, day hikes, and multiple-night backpacking trips in GSMNP, and also provides support services to hikers and backpackers, including equipment rental and shuttle services. (1335:17-1336:7)

230. During air quality alert days in GSMNP, A Walk in the Woods cannot bring its clients up to high elevations or lead strenuous tours, which results in the cancellation of hiking trips. (1336:21-1337:17) Poor air quality also forces trail guides to discuss with their clients how the poor air quality may affect their health. (1339:6-15)

231. There is a difference in the level of enthusiasm and excitement of hikers in GSMNP on good versus poor visibility days. (1339:19-1340:4) When visibility is poor, the trail guides at A Walk in the Woods "have to work a lot harder to awaken the enthusiasm that is naturally there on a great visibility day." (1337:18-22)

232. TVA has known since at least 2001 that installation of SO_2 controls on two of its power plants closest to GSMNP [Kingston and Bull Run] would reduce SO_2 emissions "by over 90% and improve the park's air quality by lessening haze, particle pollution, and acid rain." (NC Exs. 174, 137) These emissions reductions are important because "[a]ir pollution threatens the existence of many of the park's resources or significantly affects their condition, including its scenery, vegetation, streams, wildlife, and soils. Moreover, poor air quality diminishes visitor enjoyment of the park's renowned natural features and potentially affects public health." (NC Ex. 176 at 35) Nonetheless, in 2001, TVA announced that it would not complete scrubbers on Kingston and Bull Run until 2010. (NC Ex. 174; NC Ex. 136; TVA Ex. 1)

233. The National Park Service issues advisories to employees and visitors to National Parks when ozone levels are high. During the course of trial (on July 18, 2008), the National Park Service issued

such an advisory and the Air Resource Specialist for GSMNP sent an alert to its employees, encouraging them to "refrain from strenuous or prolonged physical outdoor activities." (NC Exs. 487, 488; 1361:2-25; 1241:10-1242:9) Similarly, employees and volunteers who work outside in the Appalachian Trail National Park follow a protocol that requires them to curtail their physical activities on high ozone days. (1240:3-16)

234. TVA's excess air emissions currently contribute an annual average of 0.2-0.3 $\mu g/m^3$ $PM_{2.5}$ to air quality at GSMNP; the remedy sought by North Carolina will reduce annual average $PM_{2.5}$ concentrations at GSMNP by 0.2-0.3 $\mu g/m^3$. (NC Ex. 149) TVA is currently having similar impacts at National Forests and State Parks and Wilderness Areas along the North Carolina-Tennessee border. (NC Ex. 149; 803:17-805:15)

235. TVA's excess air emissions currently contribute 2-8 ppb to maximum 8-hour ozone levels at GSMNP; the remedy sought by North Carolina will reduce maximum 8-hour ozone concentrations at GSMNP by 2-8 ppb. (NC Ex. 156; 798:8-10) TVA's current impact on maximum 8-hour ozone concentrations is greater than 8 ppb at several recreational areas in North Carolina including Mount Jefferson State Park and Cherokee National Forest; the proposed remedy will result in improvements in 8-hour ozone of greater than 8 ppb in these areas. (NC Ex. 156; 798:23-799:5)

236. The remedy sought by North Carolina will result in more than 40 days of perceptible visibility improvement each year at GSMNP, Linville Gorge, Shining Rock, Joyce Kilmer Slickrock Wilderness Area, Mt. Mitchell, Gorges State Park, and many other areas in eastern Tennessee and western North Carolina. (NC Exs. 303, 137; 1396:2-1398:1)

C. Impact on Grandfather Mountain:

237. Surveys show that scenery is the primary reason that 40% of visitors come to Grandfather Mountain and that the "mountain

experience" is the primary reason for another 20% of visitors. When visitors cannot see as much as they should be able to because of haze, it affects the quality of their visit. (1758:16-23; 1761:20-1762:8)

238. On clear days, when visitors can see the whole view, Grandfather Mountain is very busy and visitors stay at the top of the Mountain for a long time. On days when there is haze, visitors do not stay as long. (1768:2-1769:7)

239. The pH of ice from cloud water on the Mile High Swinging Bridge and trees at Grandfather Mountain was measured at 2.6 to 4.65 between 1993 and 2007. (1770:11-1771:5)

240. TVA's excess air emissions currently contribute an annual average of 0.3-0.4 $\mu g/m^3$ $PM_{2.5}$ to air quality at Grandfather Mountain; the remedy sought by North Carolina will reduce annual average $PM_{2.5}$ concentrations at Grandfather Mountain by 0.3-0.4 $\mu g/m^3$. (NC Ex. 149)

241. TVA's excess air emissions currently contribute 4-8 ppb to maximum 8-hour ozone levels at Grandfather Mountain; the remedy sought by North Carolina will reduce maximum 8-hour ozone concentrations at Grandfather Mountain by 4-8 ppb. (NC Ex. 156; 795:12-797:1)

242. The remedy sought by North Carolina will result in more than 40 days of perceptible visibility improvement each year at Grandfather Mountain. (NC Exs. 303, 137)

D. Impact on Chimney Rock:

243. Chimney Rock has been operating as a natural scenic attraction in western North Carolina for more than 105 years. (1288:10-1289:3) It welcomes approximately 250,000 visitors each year. (1289:10-14) Chimney Rock Park, long operated as a private park, has recently become one of North Carolina's State Parks. (1288:4-9)

244. Among other activities, visitors "can take in the wonderful scenic views from the top" of the 315-foot high Chimney Rock and enjoy five miles of hiking trails (1289:20-1290:6; 1290:4-6), some of which feature "incredible scenic views up and down the valley, looking back up toward little Pisgah, going toward Asheville and all the way down towards Lake Lure and out on the Piedmont plateau below" (1291:12-16; NC Exs. 270-273).

245. The primary reason visitors come to Chimney Rock Park is to experience the views and mountain scenery. (1301:6-15) Reduced visibility is "taking away one of the main selling points" for people to go to Chimney Rock. (1303:13-25)

246. Chimney Rock has de-emphasized the 75-mile views that used to be prominently featured in its marketing materials because Chimney Rock's managers did not want their visitors to be disappointed when visibility is greatly limited. (1300:4-1301:5) On the worst days of summer haze, from the top of Chimney Rock visitors can only see approximately 5-7 miles. (*Id.*)

247. TVA's excess air emissions currently contribute an annual average of 0.2-0.3 $\mu g/m^3$ $PM_{2.5}$ to air quality at Chimney Rock; the remedy sought by North Carolina will reduce annual average $PM_{2.5}$ concentrations at Chimney Rock by 0.2-0.3 $\mu g/m^3$. (NC Ex. 149) TVA's excess air emissions currently contribute 2-4 ppb to maximum 8-hour ozone levels at Chimney Rock; the remedy sought by North Carolina will reduce maximum 8-hour ozone concentrations at Chimney Rock by 2-4 ppb. (NC Ex. 156)

248. The remedy sought by North Carolina will result in more than 40 days of perceptible visibility improvement each year at Chimney Rock. (NC Exs. 303, 137)

IX. TVA's Impact on Non-Attainment Areas:

249. TVA's emissions are currently having a significant impact on air quality in non-attainment areas. (NC Ex. 148; 793:22-794:24; NC Ex. 149; 802:11-24; 804:10-19; 805:20-806:13; NC Ex. 11; 817:2-23)

250. A "non-attainment area" is an area that has been designated by EPA as not meeting a federal National Ambient Air Quality Standard ("NAAQS"). (2724:13-2725:2)

251. TVA's air quality modeling purports to show that there are no areas in North Carolina that will exceed the 15 $\mu g/m^3$ $PM_{2.5}$ NAAQS in 2013. (2248:3-2250:12) However, that modeling is based on the full implementation of CAIR (2135:22-2136:7), which has been vacated (2077:9-22; *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008)). As a result, it is unknown at this time whether there will be non-attainment areas in North Carolina or other states in the region in 2013. (800:16-801:3)

A. $PM_{2.5}$ Non-Attainment:

252. The Knoxville area of Tennessee, including all of four counties and a portion of Roane County, is not in attainment with the annual average $PM_{2.5}$ standard. (2724:13-2725:13) The non-attainment area includes TVA's Bull Run and Kingston plants – neither of which currently operates a scrubber. (1913:3-11)

253. In the late 1990's, TVA examined modeling results to understand its contribution to non-attainment in areas, including Knoxville. (NC Ex. 449 at 110:9-111:10) TVA found that it made significant contributions to Knoxville's non-attainment of the annual $PM_{2.5}$ standard. (*Id.* at 110:24-111:5) TVA learned through the SAMI modeling and other studies, at least by 2002, that TVA's Kingston and Bull Run plants have the greatest impact on the $PM_{2.5}$ levels in the Knoxville area. (NC Ex. 449 at 112:24-113:4)

254. TVA's excess SO_2 and NO_X emissions significantly contribute to annual average $PM_{2.5}$ concentrations in $PM_{2.5}$ non-attainment areas in North Carolina, Tennessee, Georgia, Missouri, Illinois, and Indiana. (801:4-802:8; NC Ex. 148 at 2; NC Ex. 149)

255. The Chattanooga area, including Hamilton County, Tennessee and the portion of Jackson County, Alabama surrounding TVA's Widows Creek plant is designated as non-attainment for annual average $PM_{2.5}$. (2724:13-2725:19; 1912:10-18) TVA only operates scrubbers on two of the six units at Widows Creek. (1912:21-23; TVA Ex. 2) It is expected that installing scrubbers on the remaining units at Widows Creek would benefit the Chattanooga non-attainment area. (1912:24-1913:2) Excess emissions from TVA's Widows Creek plant in Alabama are also currently impacting $PM_{2.5}$ non-attainment areas in Tennessee and Georgia. (802:11-23)

256. Catawba County in North Carolina is currently designated as non-attainment for $PM_{2.5}$. (2666:6-18) TVA's own modeling for this case shows that on some days, TVA's emissions contribute 30% of the total 24-hour average $PM_{2.5}$ at Catawba County. (NC Ex. 449 at 85:9-13)

B. Ozone Non-Attainment:

257. The Knoxville area of Tennessee, including part of GSMNP and Anderson County, has not attained the 8-hour ozone NAAQS that was promulgated in 1997 and is currently designated as non-attainment for 8-hour ozone. (1904:2-16; 2727:23-2729:7) TVA's Bull Run plant is located in Anderson County, Tennessee. (1831:21-22)

258. TVA knew of its emissions' impact on the Knoxville non-attainment area at least since its involvement in SAMI between 1992 and 2002. (NC Ex. 449 at 110:16-111:10) TVA's Project Manager and Team Leader of TVA's Environmental Technologies Division, Mr. Stephen Mueller, has also admitted that TVA would expect, based on the modeling done for SAMI, that, of TVA's coal-fired

power plants, Bull Run and Kingston would likely have the greatest impact on the Knoxville non-attainment areas. (NC Ex. 449 at 112:17-113:4)

259. The Knoxville area is currently not attaining the 8-hour ozone standard that was set in 1997 (1904:3-16) and will have a challenge meeting the recently promulgated standard (1905:1-8). NO_X emissions from TVA's John Sevier plant impact the Knoxville ozone non-attainment area. (1904:17-19) TVA currently does not operate any SCRs on John Sevier and has a mid-level NO_X control on only one unit. (1904:20-25)

260. The Nashville area of Tennessee is currently not meeting the recently promulgated 8-hour ozone standard. (2733:5-8; 1905:9-1906:1; 1907:17-19) TVA's witness, Mr. Quincy Styke, acknowledged that: "EPA set[] the [8-hour ozone] standard at 75 parts per billion or 0.75 parts per million. That's the standard set to protect public health and public welfare. It's being exceeded. And it would be safe to say that public health, public welfare are not being sufficiently protected because of those readings." (2730:1-7)

261. The Nashville area is currently not meeting the newly adopted 8-hour ozone standard. (1905:5-20) TVA's Gallatin, Johnsonville, and Cumberland facilities are near the Nashville non-attainment area. (1906:2-4) TVA operates SCRs on Cumberland (TVA Ex. 2), but does not operate SCRs on any of the units at Johnsonville or Gallatin, which together have a greater operating capacity than the Cumberland facility (TVA Ex. 2; 1906:5-10).

262. A study performed by TVA's Environmental Research Center and published in the Journal of Geophysical Research in 1998 concluded that the Gallatin plant can contribute as much as 50 ppb of excess ozone to the Nashville area. (1909:9-1910:4; NC Ex. 491 at 22,593) The Gallatin plant currently emits NO_X at a rate of about 0.15 lbs/mmBtu (1910:15-1911:4); installation of SCRs would reduce that emission rate by more than half (1911:22-25).

263. TVA's excess NO_X emissions significantly contribute to peak 8-hour ozone concentrations in 8-hour ozone non-attainment areas in Tennessee, North Carolina, Kentucky, South Carolina, Georgia, Arkansas, Missouri., Illinois, Indiana, and Virginia. (NC Ex. 155 at 2; Nc Ex. 156)

264. TVA's Allen plant is located near Memphis, Tennessee, in Shelby County, Tennessee. (1937:17-19) The Memphis area, including Shelby County, is not in attainment with the 8-hour ozone standard that was set in 1997. (2727:23-2728:2; 2726:4-15)

265. TVA's John Sevier plant is located in Hawkins County, Tennessee (1827:11-12), near Knoxville, Tennessee. The Knoxville area, including Hawkins County, is not in attainment with the 8-hour ozone standard that was set in 1997. (2727:23-2728:2; 2726:4-15)

266. The north-central area of Alabama, between TVA's Widows Creek and Colbert plants is currently measuring above the recently promulgated 75 ppb 8-hour ozone standard. (1906:11-18) Emissions from TVA's Widows Creek plant in Jackson County, Alabama near Chattanooga (1912:8-18) and Colbert plant near Muscle Shoals, Alabama (1836:23-1837:5) are expected to have an impact on air pollution levels in that area (1906:24-1907:2). Of the thirteen units at those plants, TVA only operates SCRs on three of the units. (1906:19-23)

267. Excess emissions from TVA's coal-fired power plants, including especially the Widows Creek plant in Alabama, are currently contributing to ozone non-attainment in Tennessee and Georgia. (806:14-807:4)

X. North Carolina's Clean Smokestacks Act:

268. North Carolina has taken concrete and enforceable steps to assure that power plant emissions within its border are being and will continue to be significantly reduced by enacting the Clean Smokestacks Act in 2002 ("CSA") (2002 N.C. Sess. Law 4) (NC

Ex. 5). The CSA requires substantial reductions in emissions from the two investor-owned public utilities that operate coal-fired power plants in North Carolina, Progress Energy and Duke Energy. (91:24-92:17) The first phase of these reductions was required in 2007 and the entire program will be completed in 2013. (90:1-14; 92:18-25; NC Ex. 5A)

269. The CSA caps the combined annual emissions from coal-fired power plants operated by Duke Energy and Progress Energy in 2013 at a total of 56,000 tons NO_X per year and 130,000 tons SO_2 per year. (NC Ex. 93; 90:1-14) These caps are reasonable emissions levels for the SO2 and NO_X emissions from coal-fired power plants operated by Duke Energy and Progress Energy in North Carolina. (90:25-91:12; 122:1-19)

270. Before making the reductions required by the CSA, the emissions rates for Duke Energy and Progress Energy were unacceptably high. (404:14-405:2; 527:20-529:14; 1777:5-1778:10)

271. Duke Energy and Progress Energy have met the 2007 NO_X emissions cap and are on track to meet the remaining NO_X and SO_2 emissions caps set forth in the CSA. (103:1-106:21; 109:20-110:12, NC Ex. 10 at 22; 405:6-9)

272. The CSA provides both civil and criminal penalties for failure to meet the scheduled emissions reductions. (99:15-21)

273. The CSA allows North Carolina to impose additional limitations on emissions of SO_2 and NO_X from individual coal-fired generating units if necessary to address air quality issues associated with an individual plant. (NC Ex. 5 at §1.F; 95:11-96:10)

274. TVA was on notice of enactment of the CSA in 2002 and TVA was specifically identified as a party that North Carolina should look to for additional emissions reductions. (610:7-13; NC Ex. 5 at §10; NC Ex. 448 at 85:8-20)

275. Subsequent to enacting the CSA, North Carolina communicated with TVA to seek a commitment from TVA to make reductions to its emissions comparable to those required by the CSA. (1785:13-1786:4; 1786:17-1787:10; 1791:20-1792:1; 1792:15-20; 1793:22-1794:3) North Carolina did not receive from TVA all of the information it wanted to determine if the reductions TVA was making under its Long Range Plan were comparable to those required under the CSA. (1804:1-7) Based upon the information it did receive, North Carolina was not satisfied with the reductions that TVA had made or promised to make. (1805:9-12)

XI. TVA's Air Pollution Control Plans:

276. TVA maintains a clean air plan ("TVA's Long Range Plan") which is based on achieving compliance with current applicable and anticipated future legal requirements. (1888:1-5; 1895:18-11) The version of TVA's plan that TVA's witnesses relied on in formulating their opinions of TVA's expected 2013 emissions in this case was based on the emissions reductions required to comply with the now vacated CAIR and CAMR. (2077:9-22; *North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008) (vacating CAIR); *New Jersey v. EPA*, 517 F.3d 574 (D.C. Cir. 2008) (vacating CAMR))

277. TVA evaluated scrubber projects during the 1990s through cost studies and an engineering report. (369:15-370:18; 370:23-371:13; 371:22-372:2; 374:20-22)

278. TVA was considering a scrubber on its Bull Run plant as early as 1997. (NC Ex. 452 at 72:11-20, 89:16-90:12)

279. In February 2001, a complaint was filed against TVA alleging violations of the Clean Air Act New Source Review ("NSR") provisions at its Bull Run facility. (1978:10-15) In 2002 TVA announced that it was going to build scrubbers at the Bull Run, Kingston, Paradise, and Colbert plants. (1978:16-18; 370:19-22; 1891:17-22) None of these scrubbers was operating as of the time of trial. (1894:4-9)

280. TVA did not commence construction of the Bull Run scrubber project until 2005, after CAIR was finalized. (NC Ex. 443 at Resp. No. 26; 1893:7-10) There is no reason from a pollution control engineering perspective that a scrubber could not have been installed earlier on the Bull Run Plant. (368:16-24)

281. Construction of the Kingston scrubber project was commenced after North Carolina filed its complaint in this case and after final CAIR regulations were promulgated. (376:22-25; NC Ex. 443 at Resp. No. 27; *see also* Doc. No. 1-1; 1893:7-10)

282. Since North Carolina filed its lawsuit, TVA has made substantial progress on completing the scrubbers at Bull Run (375:1-17; NC Ex. 87; TVA Ex. 218) and Kingston (376:1-377:15; NC Ex. 88; TVA Ex. 219), reducing the additional effort necessary for TVA to reach the emissions caps sought by North Carolina (390:14-391:11).

283. In 2006, a federal district court dismissed the lawsuit concerning NSR violations at TVA's Colbert power plant in Alabama on statute of limitations jurisdictional grounds. (1970:15-1971:2; *Nat'l Parks Conservation Ass'n v. TVA*, 413 F. Supp. 2d 1282 (N.D. Ala. 2006) *aff'd* 502 F.3d 1316 (11th Cir. 2007)) After the dismissal of the National Parks Conservation Association case concerning TVA's Colbert plant, TVA delayed the schedule for the Colbert scrubber. (379:5-10; 1971:3-9; 2826:15-2827:6) There is no current schedule for the completion of the Colbert scrubber. (1893:24-1894:3)

284. In 2006, this Court denied TVA's Motion to Dismiss the present lawsuit. (Doc. No. 20) Thereafter, and at the same time that TVA announced its delay of the Colbert scrubber project, TVA also announced a new scrubber project for the John Sevier plant in eastern Tennessee. (1827:11-1828:3; 2080:23-2082:9; 2826:15-24) Construction has not yet begun on the John Sevier scrubber project. (1892:2-3; 1895:9-11 2074:14-18; 2826:5-14)

285. TVA's Long Range Plan does not include installation of any SCRs on the John Sevier plant until mid-2014, with the completion of SCRs at the facility in 2015. (1894:18-1895:2)

286. Despite TVA's claims to be currently burning "low sulfur coal" at its Kingston, Bull Run, and John Sevier plants (TVA Ex. 2), at trial TVA conceded that the coal burned at Bull Run is not low sulfur coal and that the coal used at Kingston and John Sevier are at the absolute high end of what TVA terms "low sulfur coal." (1898:13-1899:8)

287. TVA's Long Range Plan was initially produced in discovery after October 2006. (444:3-16) By the March 6, 2007 deposition of Joe Bynum, TVA's Executive Vice President for Fossil Operations, TVA's Long Range Plan had changed. (444:17-445:15) Indeed, revision of TVA's Long Range Plan is not driven by a schedule and there is often one or more revision each year. (NC Ex. 445 at 27:6-15)

288. TVA's Long Range Plan has changed over time, including both changes to the schedules and the locations for the scrubbers. (145:10-25) Mr. Bynum admitted that the "plan, again, is not cast in concrete. You know, you put a long-range plan in place . . . you know you are not going to do that particular plan. Right now it is almost a certainty . . . . That's the one thing you know is that it will not work that way." (NC Ex. 445 at 41:5-12)

289. TVA's Long Range Plan is not a firm commitment or a legal obligation. (599:19-600:11; 2077:6-8; 1899:20-23) TVA's own counsel has claimed pre-decisional and deliberative process privilege over TVA's plan. (*See, e.g.*, 439:16-24 (characterizing some of the projects included in TVA's plan as "nonfinal government decisions" and asserting that they are not under contract and have not been approved by TVA's Board of Directors))

290. TVA's Long Range Plan is highly uncertain and is premised on federal requirements that have been judicially vacated. (321:25-322:18; 449:2-450:23; 2077:12-19)

291. CAIR was an important motivator in the decision of many utilities to install control technology to reduce their SO_2 or NO_X emissions and would have resulted in significant emissions reductions throughout the region. (2828:2-2829:8; 1878:11-19) However, CAIR has been vacated. (*North Carolina v. EPA*, 531 F.3d 896 (D.C. Cir. 2008)) "[I]t would not be surprising to see a number of utilities with plans to install scrubbers or SCRs to put some of those projects on hold" now that the CAIR has been vacated. (288:6-289:3; 291:6-18)

292. TVA has halted major capital projects in the past despite many years of construction. (2831:5-21)

293. The April 2007 version of TVA's Long Range Plan includes completion of many of the air pollution control projects recommended by Dr. Staudt in his October 2006 Report. (445:22-449:4; 451:19-24; NC Exs. 107, 108) The emissions levels that North Carolina has proposed are consistent with TVA's Long Range Plan and would require only minimal controls in addition to what was included in TVA's plan, but on an expedited schedule. (449:2-20; 450:24-451:18; 458:12-18)

The following table shows the units that were equipped with scrubbers at the time of trial, the scrubbers that were included in North Carolina's control scenario, and the scrubbers included in TVA's Long Range Plan by 2018:

	Currently Installed Scrubbers (TVA Ex. 2; NC Ex. 96)[2]	Scrubbers in NC's Control Scenario (NC Ex. 97)	Scrubbers in TVA's Long Range Plan (NC Ex. 107)[3]
Tennessee			
Bull Run	None	Scrubber	Scrubber
Kingston	None	Scrubbers	Scrubbers
John Sevier	None	Scrubbers	Scrubbers
Johnsonville	None	Scrubbers	Fuel Switching
Gallatin	None	Scrubbers	[redacted]
Cumberland	Scrubbers	Scrubbers	n/a
Allen	None	Scrubbers	[redacted]
Alabama			
Widows Creek	Units 1-6: None Units 7-8: Scrubbers	Units 1-6: Scrubbers	[redacted] Unit 7: Scrubber Upgrade
Colbert	None	Scrubbers	[redacted]
Kentucky			
Shawnee	Units 1-9: None Unit 10: Combustion Fluidized Bed	Scrubbers (all units)	Units 1-9: Scrubbers Unit 10: None
Paradise	Scrubbers	Scrubbers	Units 1-2: Upgrade Scrubbers

[2] Operational controls including use of lower sulfur or blended coal not included.

[3] Interrim controls not included.

The following table shows the units that were equipped with SCRs and SNCRs at the time of trial, the SCRs and SNCRs that were included in North Carolina's control scenario, and the SCRs and SNCRs included in TVA's Long Range Plan by 2021:

	Currently Installed SCR and SNCR (TVA Ex. 2; NC Ex. 96)[4]	SCR and SNCR in NC's Control Scenario (NC Ex. 97)	SCR and SNCR in TVA's Long Range Plan (NC Ex. 108)[5]
Tennessee			
Bull Run	SCR	SCR	n/a
Kingston	SCR	SCR	n/a
John Sevier	None	SCR	SCR
Johnsonville	None	SNCR	Units 2-4: HERTOFA [redacted]
Gallatin	None	SCR	[redacted]
Cumberland	SCR	SCR	n/a
Allen	SCR	SCR	n/a
Alabama			
Widows Creek	Units 1-6: None Units 7-8: SCR	Units 1-6: SCR Units 7-8: SCR	[redacted]
Colbert	Units 1-4: None Unit 5: SCR	SCR	[redacted]
Kentucky			
Shawnee	Units 1-9: None Unit 10: Combustion Fluidized Bed	Units 1-5: SNCR Units 6-9: SCR Unit 10: Combustion Fluidized Bed	[redacted]
Paradise	SCR	SCR	n/a

[4] Operational controls including use of overfire air and low-NO_X burners not included.

[5] Interrim measures not included.

294. To comply with the emissions levels sought by North Carolina, it will be necessary for TVA "to complete the projects that [it has] in the pipeline, . . . [and] to accelerate their long-range plan." (319:2-8; 451:19-24) Completion of all of the projects included in TVA's Long Range Plan would come close to allowing TVA to meet the proposed emissions levels. (450:24-451:18)

295. TVA's plan includes installation of additional SO_2 and NO_X controls in each of the states in which TVA operates coal-fired power plants. (453:5-12; NC Exs. 107, 108)

296. TVA's plan confirms that the air pollution control projects recommended by Dr. Staudt are feasible, necessary, and affordable. (449:7-13; 453:9-14)

297. TVA's Senior Strategic Manager for its Fossil Power Group, Michael Scott (2031:2-11) and TVA's CEO, Tom Kilgore (2814:9-23) testified that TVA will take several measures to reduce its SO_2 emissions between now and 2013, including completing installation of and operating the scrubber on its Bull Run plant (2048:10-2049:2), completing installation and operating the scrubber on its Kingston plant (2053:19-2054:8), beginning and completing installation and operating a scrubber on its John Sevier plant (2054:9-2055:1), and switching to a lower-sulfur coal at its Johnsonville plant (2061:24-2063:1; *see also* TVA Ex. 204). At trial, TVA contended that it planned to have the scrubber at Bull Run operational in 2008 (1831:17-1832:9), scrubbers at all units at the Kingston plant operational in 2009 and 2010 (1832:10-21), and scrubbers on all units at the John Sevier plant operational in 2011 and 2012 (1827:6-1828:3). (*See also* NC Ex. 107) TVA also contended that TVA plans to run NO_X controls currently installed on TVA plants year-round commencing in January 2009. (1863:12-16; 2824:22-2825:21) Mr. Scott and Mr. Kilgore expressed a high degree of confidence that these controls will be operational by 2013. (1731:23-1732:3; 2824:3-24)

298. TVA represented that these measures will reduce SO_2 emissions from Bull Run to 5,786 tons SO_2 per year (TVA Ex. 204), from Kingston to 11,368 tons SO_2 per year (*id.*), from John Sevier to 5,337 tons SO_2 per year (TVA Ex. 202), and from Johnsonville to 35,782 tons SO_2 per year (TVA Ex. 204) – to a total of 58,273 tons SO_2 per year from these four plants.

299. Nothing about the emissions caps sought by North Carolina would prevent TVA from installing the emissions controls contained in TVA's long range plan at a faster rate or discourage TVA from completing projects currently underway. (321:25-323:5; 602:5-17)

XII. Comparison of TVA's System with Duke Energy's and Progress Energy's Systems:

300. Comparing emissions of different facilities or systems of coal-fired power plants by comparing pounds of pollutants emitted per heat input, measured in millions of British thermal units, lbs/mmBtu, is an "apples-to-apples" comparison. (1880:24-1881: 16)

301. Currently, the annual NO_X and SO_2 emissions rates, in lbs/mmBtu, for Duke Energy and Progress Energy are below those of TVA. (1920:16-25) The NO_X and SO_2 emissions from Duke Energy and Progress Energy will continue to decrease to meet the caps set by the Clean Smokestacks Act. (1873:13-1874:7)

302. In 1980, TVA's annual emission rate of SO_2, in lbs/mmBtu, was more than triple the SO_2 emission rate for Duke Energy and Progress Energy. (1881:17-23) TVA's emission rate of SO_2 was higher than that of Duke Energy and Progress Energy, on a lbs/mmBtu basis, until 2001, and is again higher today. (1882:18-1883:1; 1920:11-19)

303. TVA's annual emission rate of NO_X, in lbs/mmBtu, was higher than that of Duke Energy and Progress Energy for every year from 1995 to 2007 (the only years for which comparative data are

available), and TVA's emission rate of NO_X is also much higher than that of Duke Energy and Progress Energy today. (1886:1-11; 1920:16-25; NC Ex. 503)

304. Although the NO_X emission rate for TVA's plants in Tennessee is similar to that of Duke Energy and Progress Energy during the "ozone season," that only represents half of TVA's system for less than half of the year. (1886:22-25)

305. Presently, scrubbers are installed on over 50% of the nameplate capacity for Duke Energy and Progress Energy. (1918:24-1919:6) Presently, scrubbers are installed on about 36% of the nameplate capacity of TVA's system. (1919:7-9) Even if a scrubber is installed at TVA's Bull Run plant, scrubbers would be installed on only 43% of TVA's system. (1920:1-4)

306. Over the past three-and-a-half years, Duke Energy and Progress Energy have brought on line at least the same capacity of scrubbers that TVA brought on line in the past thirty-five years. (1919:12-16)

XIII. TVA's Conduct is Contrary to Law:

307. The "permit shield" contained in several of TVA's operating permits does not protect TVA from common law nuisance actions. (1960:8-1963:12; TVA Exs. 184-194)

A. Consent Decrees

308. In the late 1970s, TVA signed consent decrees conceding that it was not in compliance with state laws of Tennessee, Alabama, or Kentucky regarding TVA's Allen, Colbert, Cumberland, Gallatin, Kingston, Johnsonville, Paradise, Shawnee, and Widows Creek plants. (1966:16-1967:5) These consent decrees required TVA to construct scrubbers on Paradise Units 1 and 2 and Widows Creek Units 7 and 8 (1967:6-18), to switch to lower sulfur coals at other facilities (1967:10-15), and to include SO_2 emissions limits in TVA's permits (1969:3-16). For the most part, the SO_2 limits added

to TVA's permits as a result of the 1970s consent decrees have not been amended since. (1969:3-6)

B. TVA's NSR Violations

309. In 2000 the EPA found that TVA had violated the New Source Review ("NSR") provisions of the Clean Air Act ("CAA") at a number of its plants. (1598:18-1599:20)

310. EPA issued an Administrative Compliance Order requiring TVA to apply for the appropriate permits under the NSR provisions, which would require TVA to install air pollution control devices, and to undertake a more comprehensive audit to reveal any additional CAA violations. (1601:22-1602:23; 1608:22-1609:8; NC Ex. 377 at 18-21)

311. EPA's Environmental Appeals Board ("EAB") reviewed EPA's Administrative Compliance Order and affirmed the majority of the Clean Air Act major and minor NSR violations (1603:15-1604:22). The EPA EAB's final determination was that TVA had committed major NSR violations at the following units:

	NO_X	SO_2	PM
Allen Unit 3	X	X	
Bull Run Unit 1	X	X	
Colbert Unit 5	X	X	X
Cumberland Unit 1	X		
Cumberland Unit 2	X		
John Sevier Unit 3		X	
Kingston Unit 6	X	X	
Kingston Unit 8	X	X	
Paradise Unit 1	X		
Paradise Unit 2	X		
Paradise Unit 3	X		
Shawnee Unit 1	X	X	
Shawnee Unit 4	X	X	

(NC Ex. 378).

312. TVA sued EPA in the United States Court of Appeals for the Eleventh Circuit, challenging the procedure EPA used in enforcing its Administrative Compliance Order, *TVA v. Whitman*, 336 F.3d 1236, 1239 (11th Cir. 2003). The Eleventh Circuit determined that it lacked jurisdiction due to an absence of final agency action. (1633:13-20; *TVA v. Whitman*, 336 F.3d at 1239) The Eleventh Circuit did not review the substance of EPA's determination (1633:16-23) and advised EPA to pursue the NSR violations in District Court (*TVA v. Whitman*, 336 F.3d at 1260).

313. To date, EPA has not pursued TVA's NSR violations judicially because of its belief in the Unitary Executive Theory. (1632:4-1633:9) However, EPA is the federal agency charged by Congress with interpretation and implementation of the federal CAA (1888:13-15; 2832:12-23) and its final determination was that TVA is in substantial violation with the CAA NSR provisions (1603:15-

1605:10). That determination has never been set aside (1633:16-23) and TVA has never resolved those violations (1599:17-20).

314. When asked by his own counsel whether TVA has violated CAA NSR provisions, Mr. Gordon Park, TVA's Manager of TVA's Environmental Compliance Section (1923:9-16) did not deny the substance of EPA's findings, but rather simply stated that "[t]here have been a number of different lawsuits. And in TVA's case, there has not been any final legal determination that TVA violated any of the [NSR] requirements." (1951:10-16)

315. If TVA had installed controls on the units identified by EPA as required by the NSR provisions (1608:22-1609:8), its NO_X emissions would have been reduced 60-70,000 tons per year (1611:1-1612:1; NC Ex. 381) and its SO_2 emissions would be reduced 64,700 tons per year (1612:15-25; NC Ex. 382).

316. EPA's Administrative Compliance Order required TVA to complete an audit of its other units to determine whether there were additional NSR violations. (1602:8-23) TVA never completed this audit. (1613:9-13) Mr. Bruce Buckheit, EPA's former Air Enforcement Director (1578:17-22), testified that if the audit were completed, he would expect a total of 300,000 tons of unlawful SO_2 emissions per year and 130,000 tons of unlawful NO_X emissions per year (1615:11-25), amounting to a total of over a million tons of excess NO_X and SO_2 emissions (1608:3-21).

317. A pending citizen suit regarding alleged Clean Air Act violations at TVA's Bull Run facility is scheduled for trial in the United States District Court for the Eastern District of Tennessee. (1978:10-25) That matter is on remand from the United States Court of Appeals for the Sixth Circuit, where the court ruled against TVA. (1978:19-21; *Nat'l Parks Conservation Ass'n v. TVA*, 480 F.3d 410 (6th Cir. 2007))

C. Clean Air Act Opacity Violations at Colbert

318. In August, 2007, the United States District Court for the Northern District of Alabama found TVA had committed more than 3,000 violations of the Clean Air Act and Alabama opacity requirements at its Colbert plant between January 3, 2000 and September 30, 2002 – resulting in over a thousand violations per year for almost three successive years. (1973:25-1974:18; NC Ex. 363)

D. TVA's Investigator General's Report of Flue Gas Leaks and Subsequent Notices of Violation by Alabama and U.S. EPA

319. On March 4, 2008, TVA's Office of the Inspector General ("TVA IG") issued a report regarding its joint investigation with the EPA Criminal Investigative Division into certain leaks from ductwork at the Widows Creek facility that were not properly corrected or reported. (1979:1-11, 1980:2-6; NC Ex. 509) The report also noted that similar significant duct leaks and reporting failures occurred at TVA's Cumberland and Paradise facilities. (1980:7-11; NC Ex. 509 at 1, 4) TVA's Bull Run plant also frequently operates with flue gas leaks. (NC Ex. 452 at 38:15-25, 39:1-40:8, 40:22-23)

320. TVA's IG found that TVA lacked transparent reporting, TVA did not exhibit a standard of care commensurate with applicable regulatory requirements, TVA was not operating and maintaining control equipment in a manner so as to minimize emissions, little, if any, consideration was given to reporting the leaks to the Alabama Division of Environmental Management ("ADEM"), and although the duct leaks had suffered significantly increased deterioration no later than May 27, 2004, TVA did not even order new ductwork until June 2005, over a year later. (1980:12-1981:24; NC Ex. 509)

321. Both ADEM and EPA have issued Notices of Violation for the Widows Creek duct leaks cited in the TVA IG report. ADEM fined TVA $100,000. EPA's Notice of Violation remains outstanding. (1981:21-1982:5; 1983:25-1984:2)

322. The TVA IG further found that TVA's emphasis was on efforts to contain the leaks while keeping the plant operating until the next major outage. (1982:25-1983:5; NC Ex. 509 at 5) The TVA IG also found that TVA's Winning Performance Scorecard program gave TVA management a financial incentive to keep the plant operating despite the duct leaks. (NC Ex. 509 at 4; 2836:9-16) Approximately 40-50% of overall compensation for the high-ranking executive officers at TVA is performance-based compensation which is based in part on that same Winning Performance Scorecard program. (2835:18-2836:8)

323. Forty to fifty percent of the compensation of TVA's high-ranking officers is based, in part, on performance under the Winning Performance Scorecard. (2836:1-16) In 2007, TVA's three top officers made about $7 million last year, which was the same amount that TVA spent on SCRs and SNCRs in 2007. (2837:17-2838:16)

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Respectfully Submitted,

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CERTIFICATE OF SERVICE

I certify that on September 15, 2008, I electronically filed the foregoing document with the Clerk of Court using the CM/ECF system which will send notification of such filing by operation of the Court's electronic filing system to the following:

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